AGRIBUSINESS MODULE OF VALUE-ADDED UNDERUTILIZED FOOD PRODUCTS TOWARDS LIVELIHOOD SUPPORT OF HILLS POPULATION

PROJECT REPORT

(2017-2020)

Award Letter NO. : F.25-1/2017/DSRPDFHS-2017-18-GE-RAJ-9809/(SA-II)
Date: 19th June 2017

Submitted to

University Grant Commission, New Delhi

By

DR. DASHRATH BHATI
(Post Doctoral Fellow)

College of Home Science
GB Pant University of Agriculture and Technology
Pantnagar,
US, Nagar, Uttarakhand

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CERTIFICATE

This is to certify that the project **"AGRIBUSINESS MODULE OF VALUE ADDED UNDERUTILIZED FOOD PRODUCTS TOWARDS LIVELIHOOD SUPPORT OF HILLS POPULATION"** has been submitted to UGC under the Dr. S. Radhakrishnan Post Doctoral Fellowship in Humanities and Social Science (Home Science, Foods and Nutrition) by **Dr. Dashrath Bhati**, under my supervision and no part of this work has been submitted for any other degree or diploma.

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(Rita S. Raghuvanshi)

16.12.20

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CHAPTER I

INTRODUCTION

Agribusiness: Agribusiness could be defined as an industry engaged in producing operations of a farm, the manufacture and distribution of farm equipment and supplies, and the processing, storage and distribution of farm commodities (Merriam-Webster, 2020). One important field of agri-business is the food processing of agricultural commodities. This sector is concerned with the processing of raw farm commodities into edible food, or with the conversion of food into other types. A significant part of food processing is the processing of harvested crops to turn them into desirable, marketable and sometimes long-term shelf-life food items.

Over the last decade, food grain production has risen from 230 million tonnes (2007-08) to 284.8 million tonnes (2017-18). In terms of horticultural produce, it raised from from 211.2 million tonnes to 311.7 million tonnes. The production of horticulture sector crops has increased as compared to the production of food grains in terms of volume. In addition to higher farm productivity, the supply chain has tremendous harvest and post-harvest losses (Jha, *et al.*, 2015). This surplus productions' management and minimization in wastage have emerged as a major challenge economically. In managing agro-product surpluses and reducing waste, the food processing sector can play an important role. Post-harvest food loss is characterised in the supply chain as observable qualitative and quantitative food loss, beginning at the time of harvest until consumption or other end uses (De Lucia and Assennato 1994; Hodges *et al*, 2011). As measured by decreased weight or volume, food losses can be quantitative or can be qualitative, such as decreased nutritional value and undesirable changes in food taste, colour, texture, or cosmetic characteristics (Buzby and Hyman, 2012).

Food losses: One element of satisfying food demand is rising agricultural production. It seems a much safer choice to supply food to customers by saving manufactured goods from losses in the fields, transport, storage, retailing, manufacturing, etc. without straining our fields, water and the atmosphere. After production, agricultural products undergo a series of post-harvest unit activities, processing and storage phases before reaching consumers. Some losses result from each operation and handling process.

Such post-harvest losses result in reductions in the supply of food. A recent study found that during harvesting, post-harvest operations, handling and storage in India, 3.9-6.0 percent cereals, 4.3-6.1 percent pulses, 2.8-10.1 percent oilseeds, 5.8-18.1 percent fruits, and 6.9-13.0 percent vegetables are lost in India (Nanda et. al. 2012). A large amount of agricultural production from the food chain is thus reduced. A preserved grain is regarded as harvested grain. It is also inevitable that the behaviours and networks where losses are substantial should be recognized. In the future, advancements in technology for these processes and channels will lead to greater product availability. The farmer will save and get more value on the market for the valuable produce. The reduction in losses across various channels would help to provide customers with better goods and will also benefit all stakeholders, including producers, distributors and consumers. The reduction in post-harvest losses would also help to ensure the country's food security.

Food processing: Earlier India had low production, but after the green revolution, food production is more than what is required and has become an exporter of the various crops. However, it has been noted that farmers' earnings have not increased as proportion the rise in output in many instances. From 1993-94 to 2015-16, real farm income has only doubled, however, farmers' income remains low in relation to the income in the non-farm sector (Ramesh Chand, 2017). Increasing the income of farmers would entail dual interventions, viz. through growth of the food processing industry, higher value addition of agricultural products and switch the farmers to off farm activities.

The country's 25 lakh micro food processing enterprises are reported to be unorganised and unregistered. In the food processing sector, unorganised enterprises share 74.3 percent of jobs (a third of which are women), 12 percent of production and 27 percent of value added. Around 66 per cent of these units are in rural areas and about 80 per cent are owned as family businesses. The organised sector accounts for 26 per cent of jobs and contributes approximately 90 per cent of production and 72 per cent of GVA (Gross Value Added). This sector majorly processes three food commodities viz. grain and starch, oils and fats and sugar and it constitute 52.1 per cent of the value of food produce. The dairy segment, with a fairly established supply chain system, has a significantly higher 14 percent share of food production among perishables. Three important perishables, on the other hand, viz. In food production, fruits, vegetables, meat and fish have a marginal share of 7.8 per cent. These perishable items lead to a large proportion of post-harvest losses. Over the last five years ending 2016-17, food production in the organised segment grew at CAGR (Compound Annual Growth Rate) by 8.3 percent, at current prices. Total perishable segments share less than 8 per cent of food output have been growing over 16 per cent CAGR. Besides this the meals and animal feed have a small share and which is other high growth segments registering growth of 31.7 and 13.3 per cent CAGR respectively. The two major traditional food products in terms of their share in output, i.e. dairy and grain mill products, have been growing at 12.0 and 10.9 per cent respectively. India's share of world food exports is a mere 2.31 per cent. Despite India's huge production base and competitive advantages, less processing and low level of value addition have been major factors hindering export success. The composition of the Indian food export basket, which basically consists of primary products such as rice, grains, flour, sugar, meat, fish, etc. reflects a low level of processing. The proportion of refined foods export is about 16 per cent, with almost 84 per cent of food exports consisting of primary commodities. Thus, despite being one of the largest food producer countries, India ranks 12th in food product exports because of our inability to step up in the value chain (Draft National Food Processing Policy, 2019).

India, despite being one of the major agri-commodity producers, continues to have a limited effect on our competitiveness and export output and farmers' income on the level of food processing and value addition.

Food processing and SAU's: ICAR and the State Universities of Agriculture (SAUs) have made a major contribution to the green revolution and the food processing sector. In 1960, in Pantnagar, then in Uttar Pradesh, the first SAU in India was created. The SAUs were autonomous organisations in charge of agricultural science, education and training or extension education throughout the state. Establishment of SAUs to improve the system of agricultural education linked to the development and processing of food in India. With its remarkable social and economic effects, the Green Revolution has seen major contributions from the SAUs, both in terms of training, the scientific workforce and the generation of new technologies (Singh *et al.* 2013). In the same way, numerous studies have been carried out on the various aspects of food production that could be beneficial in bringing about the second revolution through the conservation and productive use of food.

Livelihood by processing food: The food processing sector is the most suitable sector for creating employment for the rural poor, thus reducing the pressure on the agricultural sector to provide a livelihood for them. This is due to their knowledge of the agricultural sector, which will make it easier to train and position them in enterprises that process food. With this the production of crops are in rural India and still 60 per cent of the population lives in these rural places. The food processing industry often has a greater multiplier impact on job growth than any other sector. It is therefore critical that farmers and backward communities working in rural food processing units are treated at the top of the growth process for overall economic development. Sustainable and inclusive poverty reduction involves integrated economic development and that encourages individuals to contribute to and benefit from it.

Presently India is facing the problem of unemployment. Article published in *The Economic Times* by Ram Singh, (2020) about unemployment that the current unemployment rate is the highest in the last 45 years. The unemployment among urban youth (age 15-29 years) is alarmingly high at 22.5 per cent. The labour force participation rate has come down to 46.5 per cent for those who are 15 years and above. A large proportion of the employed workers get low wage and are stuck in ‘employed poverty’ trap. However, this situation is more worsted due to Novel corona virus and lockdown. In villages more men power is available but these men power is not engaged in gainful employment.

Skills related to food processing can play key role in serving food and nutrition security. Empowerment of rural women and small farmers for value added products can help in achieving livelihood support for them. It is effective tool to overcome the problem of unemployment, food and nutrition security and giving employment generation opportunities. Increased income, urbanisation, health and nutrition literacy and changing lifestyles are changing India's consumption habits (Regmi, 2001; Wilkinson and Rocha, 2008). The demand for packaged ready-to-eat foods is being generated by the working women, single students, professionals working out from the home city and nuclear families. Growth in organised retail, which makes readily available packaged food, is also driving food processing growth.

Due to its wide potential for growth and socio-economic effects, food processing is considered to be a growing industry. Not only does it contribute to increasing revenue, it also helps to reduce waste and add value in foreign exchange earnings through improved manufacturing productivity. Today's global economy, quality and food security have become a competitive advantage for companies processing food and supplying services. India could well become the world's food basket through proper investment in food processing, technical innovation and infrastructure in the field of agriculture sector (Meeta 2007). In present time level of processing and the degree of value addition are below than the other developed countries. The processing industry related to food is ranked fifth in terms of production, consumption, exports and expected growth (MoFPI, 2007). In diversifying agricultural operations, enhancing value-added opportunities and producing surpluses for agro-food exports, a large and competitive food processing sector plays an important role (Merchant 2008).

Local farm and non-farm produce: Foods that are usually grown locally, in the hills and wastelands can provide a solution to the problem of food security and nutritional security, particularly for people living near such places. Support for the protection, management and facilitation of fair access and sustainable use is needed for the promotion of under-processed foods. In certain situations, highly valuable uncultivated food plants, such as in home gardens, may be considered for cultivation. From an increased importance and use among people, the domestication of many crops evolved (Gari, 2002). In hilly areas the size of farms is small and farmers grow food produce in small amount. Foods grown locally can provide a solution to the problem of food and nutritional security in these areas. For this it is necessary to provide skills related to primary and secondary processing of these foods. Hence skills related to the processing of related to the crops grown in area and its production value added products may be helpful in gainful employment for small and marginal farmers. This would empower rural women and small farmers for development of value-added products and ultimately leads to livelihood support for them. Besides this food processing enhances utilization of the local crops, reduces transportation cost and post-harvest loss due to spoilage. Above all this act will help in dealing with nutritional security and at the same time local people will not migrate to other place for job searching. This is urgent need to link up both for production of the food as well as consumption of the processed foods. By doing so, lots of the problems could be resolved together. Keeping the above facts in mind the present investigation was carried out at Pantnagar, Uttarakhand with objective to study agribusiness module of value-added underutilized food products towards livelihood support for hill population.

Objectives:-

- To select under processed food for development of value-added products
- To assess nutritional qualities, antioxidant qualities and shelf life of the developed products.
- To empower women and farmers for commercialization of value-added products and using agribusiness model following food safety and security issues.
- To develop module for establishing food-based agribusiness.

CHAPTER II

REVIEW OF LITERATURE

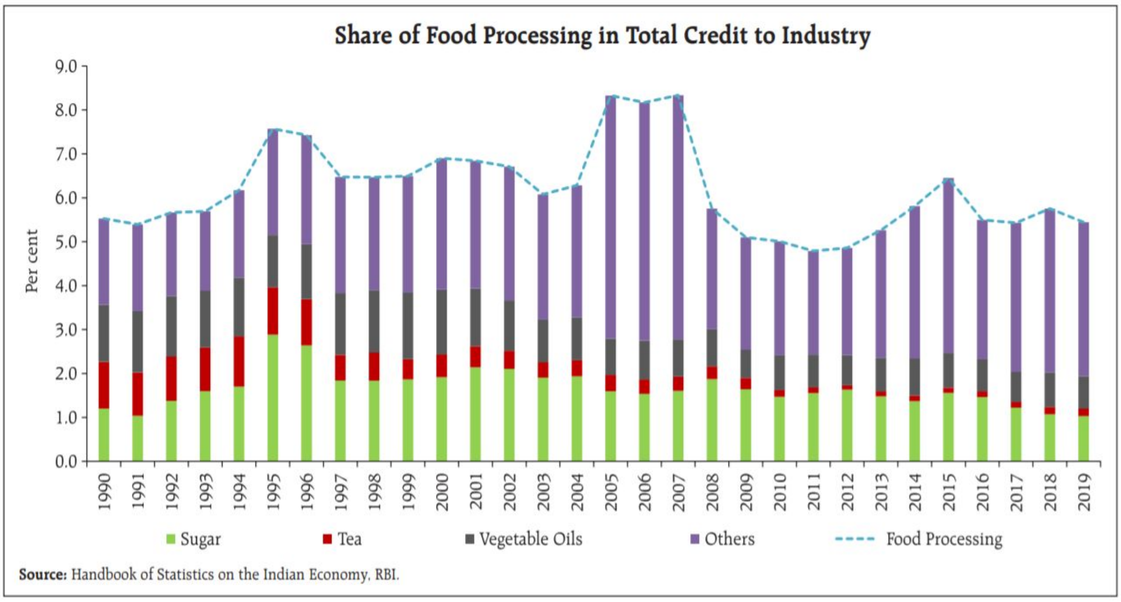
Agribusiness, based on the processing of local foods and under processed food products, can provide a solution to the wide range of problems such as food security, nutrition security, unemployment, etc. Research based literature on ginger and cowpea are compiled and presented under the following headings:

- 2.1 Overview of Food Processing Industry of India
- 2.2 Ginger:
  - 2.2.1 Origin and production
  - 2.2.2 Nutritional quality,
  - 2.2.3 Health benefits
  - 2.2.4 Processing of ginger
- 2.3 Cowpea:
  - 2.3.1 Origin and production
  - 2.3.2 Nutritional quality,
  - 2.3.3 Health benefits
  - 2.3.4 Processing of cowpea
- 2.4 Food Safety, Awareness and Practices

2.1 Overview of Food processing Industry scenario

Agriculture is one of the important sector of the Indian economy. It contributes about 14% to the GDP of India and around 11% of its total exports. About 50% Indian population still relies on agriculture as its principal source of income and serves as a source of raw material for a large number of industries. India accounts for about 2.4% of the world’s geographical area and 4% of its water resources, but it supports about 17% of the world’s human population and 15% of the livestock. Accelerated growth of agriculture production is therefore necessary, not only to achieve higher contribution towards GDP and meet the rising demand for food, but also to increase farmers’ income to ensure their inclusiveness.

The agribusiness is very important to sustain the livelihood of millions of farmers in India. It could be noted that India has a vast scope for agribusiness and also a large number of opportunities for doing agribusiness (Sundar, 2016). In 2017-18, the food processing industry accounted for 7.9 per cent of manufacturing gross value added (GVA) and 9.5 per cent in agricultural value added. It is also a major employment provider, contributing to 11.4 per cent of organised manufacturing employment. Recognising the immense potential of Food Processing Industry (FPI) in promoting inclusive growth, it has been identified as one of the key thrust areas under the 'Make in India' Programme. The share of the food processing sector **(Fig. 2.1)** in total credit to industry has moved in a narrow range, at less than 10 per cent since 1990 which is consistent with the share of FPI in manufacturing GVA (RBI Bulletin, 2020).



Source: Handbook of Statistics on the Indian Economy, RBI.

Figure 2.1: Share of food processing in total credit to industry

As per Annual Survey Industries (2016-17), the total number of factories in the registered food processing sector in the country was 39,748. Among these industry, highest numbers of registered factories are located in 'Andhra Pradesh', which accounts for about 14.75% of the total registered factories in FPI sector industries followed by 'Tamil Nadu' (12.77%) and 'Telangana' (9.99%), Punjab (7.31%) and Maharashtra (7.06%). However, Uttarakhand's shared only 0.94% registered factories (MOFPI, 2019). Overall, the per centage of women in the food processing sectors is very low (Table 2.1).

Table 2.1: Women Employment in Food Processing Sector

Sector	Employed Women Workers (in lakh)	Total Employment Food Processing Sector (in lakh)	(%) Share of Women
Registered Factories (2016-17)*	2.33	18.54	12.55
Un-incorporated Non-Agriculture Enterprises in Food Processing sector (2015-16) @	12.62	51.11	24.69

* Source: Annual Survey of Industries (2016-17); @Source: NSS 73rd Round (July 2015-June 2016)

Popularization of food processing activities related awareness among masses is needed to minimize wastage and give a fillip to rural entrepreneurship, Food Processing Training cum Incubation Centres impart ‘hands on’ training in processing, preservation and storage of locally grown agro-produce, particularly perishables, facilitate transfer of technology and also offer incubation services on food processing and food business to budding entrepreneurs. Women will be given priority for training and incubation services in these centres (Draft National Food Processing Policy, 2019).

2.2 Ginger:

2.2.1 Origin and production:

Ginger (Z. officinale Rosc.) is a member of Zingiberaceae family. It is grown in tropical and subtropical regions, since decades for the purpose of spice and medicine. Over 1200 species and 53 genera, the Zingiberaceae is the biggest in the eight families of the order (Kress, 1990). This is a member of the plant family that includes highly valued premium spices group. The ginger plant has great history of planting in the Asian subcontinent, probably originated from South East Asia from where it was exported to different countries of the world (Ravindran and Nirmal, 2005; Dedov *et al.,* 2002). Ginger is a cultivated in many tropical countries of the world (Singletary, 2010).

In the year 1807, William Roscoe (1753-1831), an known English botanist, gave name *Zingiber officinale* to this aromatic plant. In reference to the protrusions on the ginger rhizomes, the name 'Zingiber' of the genus comes from a Sanskrit denoting 'horn shaped' (Ghosh *et al.,* 2011). Traditionally the ginger rhizome domesticated as a spice since ages. This is a swollen stem or rhizome found underground the plant which is edible component. Ginger plants are differentiated by its tuberous or non-tuberous rhizomes and have good aromatic and medicinal properties (Chen *et al.,* 2008). Ginger essential oil mainly consists of sesquiterpenes, carbonyl compounds, alcohols, and monoterpene hydrocarbons (Onyenekwe and Hashimoto, 1999), all of which contribute to the well-known aroma and flavour of ginger.

The plant is grown throughout the humid tropics regions of India and produces highest ginger in world (Pandotra *et al.,* 2013). India and China are believed to produce the ginger for therapeutic or medicinal purposes for over 5000 years to treat wide range of disease at household level. Ginger was an important crop for the purpose of trade and was exported from India to Empire of Roman over 2000 years ago, where it was especially valued for its therapeutic properties.

Morphology of the ginger plant is perennial, rhizome having erect annual stem invested by smooth sheaths of leaves, 2 to 3ft. in height. The rhizome that has the horizontal stem from which the roots grows and it is the main part of ginger that is utilized as spice in different forms such as dried, preserved, and greens (Pandotra *et al.*,2013).

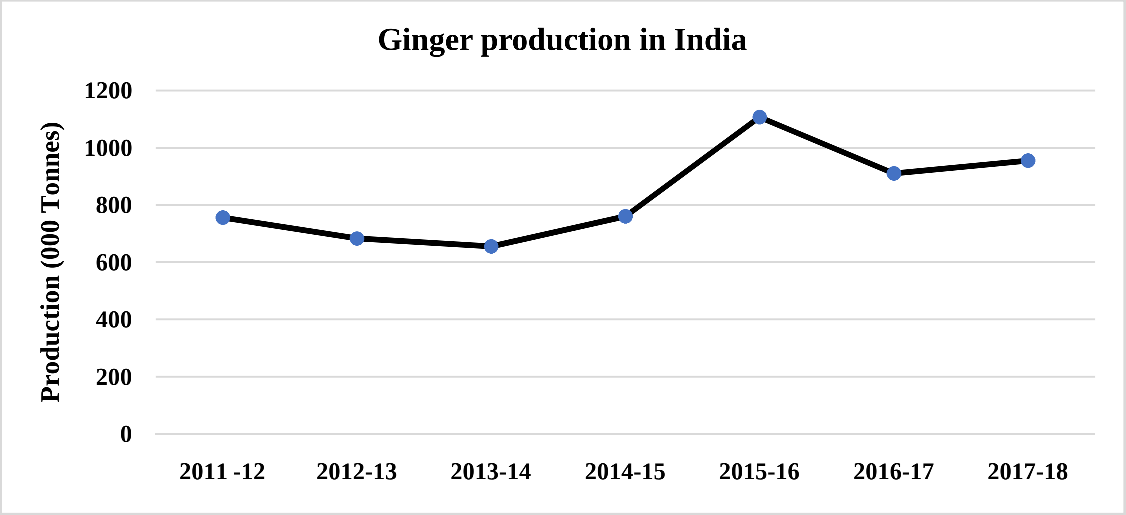


Figure 2.2: Ginger production in India

India is the largest producer of ginger and the data presented by Ravindran and Nirmal, (2005) indicated that the production of ginger is 2,63,170 tonnes per year from approximately 77,610 hectares of area. This account approximately 30 to 40 percent of world production. The production of ginger since 2011-12 to 2017-18 is presented under the fig. 2.2 (Source: National Horticulture Board, 2020).

2.2.2 Nutritional quality

Ginger rhizomes is rich in various nutrient (table 2.2). Zingibain is a potent proteolytic enzyme present in this ginger rhizomes. The nutritional and other active components varies according to the variety, type, conditions related to agro-climate. Event curing methods, drying and storage conditions also drastically affect ginger constitutes (Agrahari, 2015). Its sscorbic acid and carotenoids content were found to be 10.97 and 92.96 mg per 100 g, respectively. Wijekoon *et al.,* (2011) evaluated the nutritional quality of torch ginger inflorescence (Etlingera elatior Jack.) and noted the higher dietary fiber content, essential amino acids (lysine and leucine) and unsaturated fatty acids (linoleic acid, palmitoleic acid and oleic acid). The study revealed that inflorescence of torch ginger is a rich source of different minerals such as potassium 1589mg, calcium 775mg, magnesium 327mg, P 286mg, and sulphur 167mg in 100gm with lower levels of heavy metal also.

Table 2.2: Nutritional quality of fresh ginger rhizome

Parameters	**Range**	**References**
Moisture (%)	75.20-94.17	Ahammed *et al.,*2014; Tanveer *et al.,* 2014; Kaushal *et al.,*2014; Eze and Agbo 2011; Ghosh *et al.,*2011; Phoungchandang and Sertwasena 2010; Puengphian and Sirichote, 2008 and Singh *et al.,* 2001
Total soluble solids (^{o}B)	3.33-6.67	Kaushal *et al.,* 2014 and Eze and Agbo, 2011
Carbohydrates (% of CHO)	12.3	Ehsanullah *et al.,* 2013
Ascorbic acid (mg/100g)	1.04-9.33	Ahammed *et al.,*2014; Latona *et al.,* 2012; Shahid and Hussain, 2012 and Shirin and Prakash, 2010
Starch (%)	40.4-59.0	Akande *et al.,* 2014 and Jadhav *et al.,*2012

Parameters	**Range**	**References**
Proteins (%)	1.2-15.0	Ahammed *et al.,*2014; Ehsanullah *et al.,* 2013; Shahid and Hussain, 2012; Okolo *et al.,* 2012; Ghosh *et al.,* 2011; Ghorab *et al.,* 2010; Dhingra and Kumar, 2005; Nwinuka *et al.,* 2005; Panhwar 2005 and Mallorea *et al.,*1992
Fat (%)	0.8-1.0	Ahammed *et al.,* 2014; Ehsanullah *et al.,*2013 and Ghosh *et al.,*2011
Fibre (%)	0.50-10.8	Kaushal *et al.,* 2014; Ehsanullah *et al.,* 2013; Virendra *et al.,* 2013; Jadhav *et al.,*2012; Kizhakkayil and Sasikumar, 2009 and Singh *et al.,*2001
Ash (%)	0.69-2.3	Ahammed *et al.,* 2014; Kaushal *et al.,*2014; Rahman *et al.,*2013; Shahid and Hussain, 2012; Ghosh *et al.,*2011; Ghorab *et al.,*2010; Singh *et al.,*2001 and Gopalan *et al.,* 2004

Pandotra and co-workers (2015), collected ginger from north western Himalayan India and studied it's germplasm. The study concluded that raw ginger rhizome was good source of minerals like magnesium, calcium, manganese, iron, copper and zinc (Gupta *et al.,* 2010). Evaluation of Malaysian ginger rhizome and Nigerian ginger revealed higher moisture content, crude fiber, and lower in carbohydrate than the USDA database (USDA Nutrient Database, 2013). Multi-elemental profiling of ginger was also done for the assessment of different elements and nutritional quality and quantity in ginger rhizome. This revealed that ginger rhizomes contained 18 quantifiable elements (Gupta *et al.,* 2010). The rhizomes digested by acid was having wide range of minerals (Badreldin *et al.,* 2008).

2.2.3 Health benefits

Since ages, ginger has been utilized as a medicinal plant all over the world. It is widely used for treatment of various ailments ranging from arthritis to rheumatism, sore throats to muscular aches and pains, constipation to vomiting or digestion related problems, hypertension to cardiovascular diseases, fever to infectious diseases (Ali *et al.,* 2008). Ginger has direct anti-microbial activity and thus can be used in treatment of bacterial infections (Tan and Vanitha, 2004). Ginger extract has also been widely used as herbal medicine, with broad anti-inflammatory (Grzanna *et al.,*2005), anti-cancerous (Habib *et al.,*2008), and antimicrobial (Giriraju and Yunus, 2013) properties. The health-promoting effect of ginger is typically attributed to the presence of rich phytochemicals, known to prevent lead-induced liver tissue apoptosis in rats (Khaki & Khaki, 2013); reduce the total plasma cholesterol, liver cholesterol, and aorta atherosclerotic plaque in hamster models (Lei *et al.,* 2014); and prevent high-fat diet induced obesity in mice (Misawa *et al.,*2015). In addition, the non-volatile pungent compounds present in ginger, such as gingerols, shogaols, paradols, and zingerone (Jolad *et al.,*2004) have been reported to exhibit antioxidant activity driven by the elimination of free radicals (Maisuthisakul *et al.,* 2007). The various health promoting activities of ginger are presented in table 2.3. Other then it's uses as flavouring agent, ginger is known for medicine in different medicinal ideology such as ayurvedic, unani medicine, allopathic, aromapethy and household medicines (Srivastava and Mustafa, 1989; Shelly *et al.,*2004; Sloand and Vessey, 2001, Fessenden *et al.,* 2001).

Table 2.3: Mode of action of active constituents present in ginger

Biological action	**Active constituents**	**Mode of action**	**References**
Nausea and vomiting	Gingerols, shogaols, Sesquit-erpenes and monoterpenes	Anti-cholinergic and anti-serotonin action	Bryer, 2005
Hypolipidimic activity	Ethanolic extract of ginger	By reducing triglycerides and LDL cholesterol and to increase HDL	Bolanle, 2011
Inhibits the cell invasion	Anticancer agent e.g. breast cancer	reduction in matrix metalloproteinase-9 expression	Ling *et al.,*2010
Hypoglycemic effect	Zingiberone	Lower blood sugar level by inhibition of oxidative stress and increase insulin sensitivity.	Vats *et al.,*2002; Shanmugam *et al.,* 2011

Biological action	Active constituents	Mode of action	References
Neuroprotective effect	Phenolic and favonoids compounds	Accelerate brain antioxidant defence mechanisms	Shanmugam *et al.,*2011
Osteoarthritis (knee joints)	Highly purified ginger extract	Reduce the inflammatory mediators.	Bliddal *et al.,* 2000; Altman and Marcussen, 2001
Anti-ulcerative	Gingerol (6) and shogaol (6)	Suppress the gastric contraction, increasing mucin secretion	Minaiyan *et al.,* 2006
Hypotensive activity		lower blood pressure by inhibition of voltage dependent calcium channels as well as by stimulat muscarinic receptors	Ghayur *et al.,* 2005; Nicoll and Henein, 2009
Anti-viral activity	Sesquiterpenes (B-Sesquiphellandrene)		San Chang *et al.,* 2013
Antiplatelet effect	Gingerol and shogaol	lower platelet thromboxane X2 and prostaglandin E2 production	Tjendraputra *et al.,* 2003

Dried ginger and its derived products such as oil and oleoresins are used as nutraceuticals and pharmaceuticals purposes and valued highly at international trade. The spicy aroma is primarily due to ketones, principally different gingerols present in ginger rhizomes which was studied a lot if the different health-related scientific research studies. The rhizomes consist of polyphenolic compounds i.e. gingerol homologs and shogaols, that possess a high antioxidant activity (Bartley and Jacobs, 2000). In addition, ginger is also notified as detoxifying agent against alcohol abuse and bromobenzene intoxication (Stoilova *et al.,* 2007). The ginger rhizome is also considered as antidiabetic, antihyperlipidemic, and hepatic anticancer effects (Akimoto *et al.,* 2015; Hamed *et al.,* 2012; Bordia *et al.,*1997).

In a randomized, double-blind, clinical trial on type II diabetic patients total of 41 were randomly given ginger or placebo (22 ginger administered and 19 placebo), received 2 g/day of ginger powder supplement or placebo for 12 weeks. Ginger supplementation received group significantly reduced the fasting blood gulucose level, hemoglobin A1c, apolipo-protein B, apolipo-protein B/apolipo-protein A-I and malondialdehyde as compared to baseline, as well as control group, while it increased the level of apolipoprotein A-I at $p \leq 0.05$ significance level (Khandouzi *et al.,*2015).

An experimental study conducted on seventy rats. These rats were investigated for 4 week to evaluate the effect of ginger at doses. The rate were fed on 100 and 200 mg/kg body weight and intoxicated rat with cadmium at dose of (5mg/kg) using biochemical and histological analysis. Renal dysfunction, kidney tissue damage, and oxidative effect were noticed in cadmium intoxicated rats and noted significantly increased in creatinine and urea; decrease in creatinine clearance and reabsorption rate of urine albumin, increase in MDA, decrease in total antioxidant status, reduction in DNA content, and histopathological changes of kidneys' tissues compared to control rats. Treatment with ginger resulted in significant restoring of renal function biomarkers, total antioxidant status, molecular DNA, and histological improvements which occurs via free radical scavenging and regenerative mechanisms. The activity of ginger was supported by estimation of bioactive phenolic and flavonoid constituents. Twenty-eight polyphenolic compounds were estimated in ginger extract; gingerol (6), shogaol (6), citral and pyrogallol were the highest amounts in ginger, and supposed to be responsible for its major antioxidant and free radical scavenging activity as shown by In vitro DPPH/b-carotene-linolic acid assay tests. These results indicated that, ginger extracts have a potent protective effect against nephrotoxicity induced by various toxicants (Gabr, *et al.,* 2017).

The optimum conditions for the maximum yield of polyphenols from each gram of ginger were found to be 75 % aqueous ethanol, 40 °C temperature and extraction time of 60 min respectively. The order of relative importance of these three parameters was: ethanol > time > temperature. It was concluded that at lower concentration ethanolic extract of ginger possess high antioxidant activity in comparison with synthetic antioxidants like vitamin C or BHT and thus it can be applicable as potent natural antioxidant in food and pharmaceutical industries for the preparation of functional food (Mukherjee *et al.*, 2014).

The effect of consumption of ginger on the heart rate and blood pressure (BP) was studied in group comprised of 22 males and 38 females (total of 60 subjects). The subjects were in 3 groups of 20 each; a Control group (distilled water) and 2 experimental groups (100mg/kg bodyweight and 50mg/kg bodyweight of oral consumption of ginger extract). For each group, three readings were obtained per subject- one before administration, and the other two readings at intervals of 2hrs and 4hrs after consumption of water or ginger. The readings taken comprise of systolic BP, diastolic BP, and the heart rate. Results showed a significant ($p \leq 0.05$) decrease in all measured parameters 2hrs after ginger administration and a significant ($p \leq 0.05$) increase in only the systolic BP, 4hrs after ginger administration. It was concluded that consumption of ginger has a blood pressure lowering effect and this effect is dose-dependent (Ojulari *et al.,* 2014).

2.2.4 Processing of ginger

Ginger contains polyphenols, terpenoids, isoterpenoid compounds i.e. gingerol and its derivatives. These components makes ginger effective against several pathological conditions like common cold, high cholesterol, ulcers, atherosclerosis, sore throats, indigestion, diabetes and cardiovascular diseases. Thus its use all over the world as alternate therapeutic use in the form of a spice, condiment, ginger paste, dried powder etc. (Radhika *et al.,*2017; Badreldin *et al.,*2008). However, its pungent aroma and sharp, spicy flavour leads to limit the opportunities to develop processed food products from ginger. Consequently, few ginger-based products are available in the market (Radhika *et al.,* 2017; Nath *et al.,*2013).

Ginger is valued as a spice because of its aroma and pungency (Paull *et al.,* 1988) and has been used through ages in almost all systems of medicine against many maladies due to its medicinal properties (Kubra and Rao, 2012). Ginger rhizome can be utilized in the form of fresh paste, ginger tea (flavouring), dried powder and preserved slices (Ghorab *et al.,* 2010). Ginger can be used in different commercial products like cookies, candy, teas, tinctures, sodas, jam, beer, capsule and syrup (Maxwell, 2008). Other products made by use of ginger as main or flavouring agent such as ginger bread, confectionery, ginger ale, curry powders, certain curried meats, table sauces, in pickling and in the manufacture of certain soft drinks like cordials, ginger cocktail, carbonated drinks, etc. Ginger is also used for the extraction of ginger oil, oleoresin, essences, tinctures etc. (Pruthi, 1998).

Analyses of headspace oxygen depletion and fatty acid content clearly demonstrated that Ginger extract (GE) and its four pure constituent components 6-gingerol (6GE), 8-gingerol (8GE), 10-gingerol (10GE) and 6-shogaol (6SGE) were able to inhibit the oxidation of fat present in canola oil at different temperature and concentration regimes. 10GE and 6SGE exhibited higher antioxidant abilities than 6GE and 8GE did at 60 ^{O}C. This increased antioxidative activity was attributed to the presence of hydroxyl groups and suitable solubilizing side chains. Of the compounds examined, GE exhibited the strongest antioxidant properties, particularly at 60, 90 and 120 ^{O}C. The improved antioxidant properties of GE were considered to arise from other components present in this extract but not found in the isolated components, as well as 8-shogaol and 10-shogaol. In addition to the already known compounds 8-shogaol (0.5%, w/w) and 10-shogaol (1.8%, w/w), there still remain further unknown compounds constituting more than 50% (w/w) of GE. Overall, GE and the four pure constituents examined—widely available owing to the popularity of the ginger plant—exhibited dose dependent antioxidant activities, thus demonstrating their potential application as natural antioxidants in fat-containing processed food products (Wenhui *et al.,* 2018).

Alam *et al.* (2018) developed ginger candy and evaluated nutrient composition. It was noted that nutrient component of the ginger candy was inversely proportional to the concentration of sugar. It was noted that the total bacterial load was increased with increasing the sugar concentration. The ginger candy made with 50% sugar solution was noted best for highest nutrient and lowest microbial count than candy developed by 60% and 70% sugar concentration. Siddiqui *et al.,* (2012) conducted an experiment and developed candy from fresh ginger and studied their storage life. The candy (GC75) made from 75% sugar concentration was best. Higher concentration of sugar and slower processing gives higher acceptability for candy. Among different changes, moisture concentration was prominent during preparation of candy. The moisture content was 37% for candy respectively which were nearly half of the initial concentration of fresh ginger. The storage stability of candy (90 days) was higher than storage stability of preserve 60 days.

Ginger candy, slice thickness (5.0-25.0 mm) and blanching length (10-30 min) were evaluated by Nath and co-worker (2013). The ginger slices were dipped in 40 °B and 75 °B sugar concentration with 2 per cent citric acid, respectively. For slice thickness of 10.9 mm and blanching period of 24.9 min, the optimum product qualities in terms of hardness (2.08 kg), TSS (73.4 percent), acidity (1.31 percent), TSS: acid ratio (56.3), taste score (7.98) and overall acceptability (8.07) were noted. However, Kumara *et al.,*(2018) studied the effect of blanching time and beetroot pomace extract on physicochemical parameter and phytochemicals content among the developed ginger candy. Blanching time and beetroot pomace extract concentration has a significant effect on the phytochemical properties of the ginger candy. The optimum process conditions for production of antioxidant rich ginger candy was found to be 7.81 min blanching time and 9.24% beetroot pomace extract concentration with 0.905 desirability.

Ginger extract and amla pulp mixed toffee were evaluated organoleptically and stored under ambient and refrigerated conditions for 90 days. The different composition of aonla pulp and ginger extract toffee were evaluated and observed that 80:20 w/w (aonla pulp: ginger extract) was found to be higher in terms of yield, organoleptic properties and nutritional quality. Stored toffee showed that as the length of the storage period increased, the content of TSS, reduction and total sugars increased, while the content of moisture and acidity decreased. At the ambient temperature, the reaction rate was relatively higher than at the refrigerated temperature. While the sensory quality of the toffees also decreased faster during 90 days of storage under ambient conditions than under refrigeration, even after 90 days under either environment, the toffees were found to be appropriate (Nalage *et al.,* 2014).

Extracts of pineapple, turmeric and ginger were blended in the ratios 13:6:1, 6:3:1 and 4:3:3 (v/v) to prepare turmeric: ginger: pineapple-flavoured drinks. The drinks prepared from the 6:3:1 and 4:3:3 ratios of turmeric, ginger and pineapple extracts were acceptable to the panellists, and these drinks were found to be as good as the standard commercial pineapple drink used. (Ekeledo *et al.,*2013). Other study was conducted by Lal, *et al.,*(1999) developed squash by using apple pulp, lemon juice and ginger. Based on sensory analysis, a combination of 25 per cent of apple pulp, 15 per cent lemon juice and 10 per cent of ginger was found most acceptable. The squash was stored and concluded that these could be stored for six months it without undesirable chemical and microbial changes at room temperature. Ahammed *et al.*,(2014) conducted experiment on ginger juice to study the total viable counts (bacteria, yeast and mould) and observed low microbial load. The mean score for color, flavor, pungency and overall acceptability of the juice secured score within the acceptable limit ranging from 6.30 to 8.0, ranking like slightly to like very much.

The effervescent product of red ginger extract was made from a mixture of red ginger extract, citric acid, sodium bicarbonate, dextrose, mannitol, sucralose and polyethylene glycol. This study used a single factor randomized complete design method with the ratio of different concentrations of citric acid and sodium bicarbonate (50:50, 51:49, 52:48, 53:47, 55:45). The results showed that the addition of different concentrations of citric acid and sodium bicarbonate had significant effect ($sig \leq \alpha = 0.01$) on the value of soluble and effervescent pH of red ginger extract and significantly affected the level of color preference, taste and effervescent solubility of red ginger extract. The best effervescent product of red ginger extract was selected based on the hedonic test with the ratio of citric acid and sodium bicarbonate 52:48 with the following quality test results: 0.00% ethanol residue; levels of active red ginger 0.65%; and the level of effervescent red ginger extract 0.52% (Giyatmi and Lingga, 2019).

Jayashree *et al.* (2014), studied the quality of dry ginger rhizomes by using different drying methods. The initial moisture content was observed 81.3 % to final the moisture content was less than 10 % in different drying methods like sun drying, solar tunnel drying and cabinet tray drying. Slicing of ginger significantly reduced the drying time in all the drying methods. It was noted that the whole ginger took the maximum time i.e. 9 days for drying followed by solar tunnel drying (8 days). As the slice length decreased, substantial decreases in the essential oil and oleoresin content of dry ginger were found. As determined using gas chromatography, the significant constituents of basic ginger oil such as zingiberene, limonene, linalool, geraniol and nerolidol were also found to decrease during slicing and as the drying temperature increased. As calculated using a reverse phase high performance liquid chromatography, the pungency constituents in ginger oleoresin such as total gingerols and total shogoals also showed a decreasing trend in slicing and with the rise in drying temperature. It was observed from drying studies that the maximum essential oil (13.9 mg/g) and oleoresin content (45.2 mg/g) of dry ginger is retained by whole ginger rhizomes dried under sun drying or in a solar tunnel dryer. The drying temperature of 60 ° C was considered optimal for mechanical drying, but at this temperature there was around 12.2 percent loss in essential oil.

2.3 Cowpea

2.3.1 Origen and Production

The cowpea is familiar by different names such as bachapin bean, black-eyed pea in English. Usually cowpea pods contains 8 to 20 seeds per pod. Seeds differ considerably in size, shape and tint. These cowpea seeds are relatively large, 2 to 12 mm long and weigh 5 to 30g/100 seeds. Cowpea is considered more tolerant to drought than soybean or mung bean because of its tendency to form a deep taproot. It has a competitive niche in sandy soils and does not tolerate excessively wet conditions and should not be grown on poorly drained soils (Dudi *et al.,* 2019).

Although accurate statistics are generally unavailable, cowpea production worldwide is estimated at about 6.5 million metric tons annually on about 14.5 million hectares. About 83% of the global cowpea production is obtained in Africa, with over 80% of African production in West Africa. Nigeria, with an estimated 45% of the world cowpea production and over 55% of the production in Africa, is the world's largest producer and consumer of cowpea, followed by Niger (15%), Brazil (12%), and Burkina Faso (5%). Over the last three decades, global cowpea production grew at an average rate of 5%, with 3.5% annual growth in area and 1.5% growth in yield, and the area expansion accounting for 70% of the total growth during this period (Fatokun *et al.,* 2012). Globally, the share of cowpea in total area under pulses grew from ≤ 10% in 1990 to nearly 20% in 2007. In West Africa, cowpea occupies over 85% of the area under pulses and 10% of the total cultivated land (Fatokun *et al.,*2012). If these past trends in cowpea area expansion and yield continue into the future, the global cowpea supply is projected to reach 9.8 million tons in 2020 and 12.3 million tons in 2030, against the projected global demand of nearly 8.5 million tons in 2020 and 11.2 million tons in 2030 (Boukar *et al.,* 2016).

2.3.2 Nutritional quality

Cowpea seeds are important source of proteins (22-25 g/100 g) whose proportion depends on the variety analyzed (Khattab *et al.,* 2009). Besides this, considering the carbohydrate content (50-65 g/100 g) and the amino acid pattern complementary to that of cereal grains, which makes cowpea a potentially important nutritional component in the human diet (Prinyawiwatkul *et al.,*1996). Various nutrients analysed in cowpea are presented in table **2.4.**

Table 2.4 : Nutritional quality of cowpea in different study

Parameters	**Range**	**References**
Moisture (%)	11.10-19.35	Rajpoot and Rana, 2016; Hamid *et al.,*2016; Obasi *et al.,*2014
Carbohydrates (%)	55.90-62.45	Rajpoot and Rana, 2016; Hamid *et al.,*2016; Obasi *et al.,*2014
Proteins (%)	7.04-32.00	Rajpoot and Rana, 2016; Perles *et al.,*2016; Hamid *et al.,*2016; José *et al.,*2014; Obasi *et al.,*2014;
Fat (%)	0.49-5.46	Rajpoot and Rana, 2016; Hamid *et al.,*2016; Perles *et al.,*2016; Obasi *et al.,*2014
Fibre (%)	1.88-5.70	Rajpoot and Rana, 2016; Hamid *et al.,*2016; Obasi *et al.,*2014;
Ash (%)	2.60-4.70	Rajpoot and Rana, 2016; Hamid *et al.,*2016; Perles *et al.,*2016; Obasi *et al.,*2014
Calcium (mg)	110	Rajpoot and Rana, 2016
Iron (mg)	8.27	Rajpoot and Rana, 2016
Magnesium (mg)	184	Rajpoot and Rana, 2016
Phosphorus (mg)	424	Rajpoot and Rana, 2016
Potassium (mg)	1112	Rajpoot and Rana, 2016
Zinc (mg)	3.37	Rajpoot and Rana, 2016

Physical characteristics and nutritional composition of improved grain cowpea varieties and compared with Pusa Komal (PK) improved variety of cowpea developed by IARI, Karnal. Grain cowpea varieties were significantly larger in size, higher seed weight, higher hydration and swelling capacity than Pusa Komal (PK). Bulk density of grain cowpea varieties (0.714 - 0.76 g/ml) was significantly lower than PK (0.812g/ml). Leaching losses in PL-1, PL-4, PL-5 and PGCP-13 (11.72 -12.26 %) was significantly lower than PK (13.65%). The proximate composition of PK viz. ash (4.02%), crude fat (1.04%), crude protein (24.4%), crude fiber (3.63%) and carbohydrate (66.91%) were significantly lower in comparison to different grain cowpea varieties. Phytate content was significantly low in PGCP-11, PL-4 and PL-3 (ranged from 184.77 to 203.31 mg/100g) than PK (204.24 mg/100g). The tannic acid content of PL-1, PGCP-13 and PL-3 was significantly lower than PK i.e. 0.68% (Verma *et al.,* 2019).

2.3.3 Health benefits

Cowpea is a staple food that provides for human nutrition large amounts of proteins, carbohydrates, dietary fibres, vitamins of the β complex, essential minerals, a small quantity of lipids, and has lower levels of anti-nutritional factors (Moreira-Araújo *et al.,*2017; Mtolo *et al.,* 2017; Nassourou *et al.,* 2016). Cowpea seeds also contain bioactive compounds that may be beneficial to human health (Nassourou *et al.,* 2016; Perera *et al.,* 2016). Phenolic compounds, the most important group of bioactive compounds in cowpea, are concentrated in the seed coat and have the potential to protect the body against chronic diseases (Mtolo *et al.,* 2017; Awika and Duodu, 2016). The phenolic compounds are responsible for most of the coloration observed in diverse cowpea seeds. The major phenolic compounds present in leguminous seeds, particularly in cowpea, are the phenolic acids and flavonoids (Awika and Duodu 2016; Zhao *et al.,* 2014). Flavonoids also play an important role in plant protection (Nassourou *et al.,* 2016). Phenolic compounds are believed to be responsible for the antioxidant and other health-promoting properties of cowpea (Apea-Bah *et al.,* 2017). Epidemiological studies have reported that the consumption of phenolic antioxidants-rich foods protects against human chronic non-communicable diseases such as cancer, ageing, diabetes, and cardiovascular disease. Phenolic compounds act as scavengers of radicals, reducing agents, and metal ion chelators (Zhao *et al.,* 2014). According to Kapravelou *et al.,*(2015), cowpea seeds exhibit beneficial health effects related to their antioxidant, hypoglycaemic, hypolipidaemic, and antihypertensive properties.

'Koose' a side dish prepared by deep frying thick cowpea paste, which is part West African food. The research conducted by Apea-Bah *et al.,* (2017) to study the impact of deep-frying on the cowpea paste and its total phenolic, phenolic and antioxidant properties. Four cowpea varieties, among them a brownish-cream and a cream phenotypes two reddish-brown varities, were utilized for making cowpea paste. The phenolic acids were identified included benzoic and derivatives of cinnamic acid. It was noted that deep frying of the cowpea pastes resulted in decreased total phenolic, radical scavenging activity and total quantified flavonoid content.

Cowpea white contain DPPH scavenging Activity 11.1%, e ferric reducing power activity (FRAP) 4.92 ± 0.09 µg AAE/mg and reducing power activity 1.30 ±1.20 µg AAE/mg. However, cowpea brown contained DPPH scavenging activity 54.4%, FRAP 22.60 ± 0.02 µg AAE/mg and reducing power activity 40.50 ±0.62 µg AAE/mg (Petchiammal and Hopper 2014). Several studies conducted on functional properties of cowpea during 2004 to 2018 are summarized and presented in table 2.5.

Table 2.5: Functional properties and pharmacological properties of cowpea

Active constituents	**Functional properties**	**Physiological effects**	**References**
Phenolic compounds	Antidiabetic	Inhibit α-amylase and α-glucosidsae activity	Key *et al.*,2004
	Antihypertensive	ACE inhibitory activity	Key *et al.*,2004
	Hypocholesterolemic	Inhibit oxidation of lipids. Decreasing of blood triglyceride, cholesterol total, LDL, and increasing of blood HDL	Owuamanam *et al.,* 2014; Hachibamba *et al.,* 2013; Cui *et al.,* 2012
	Anti-inflammatory	Suppress expression of pro-inflammatory genes	Ojwang *et al.*,2015
	Anticancer	Antioxidants protects DNA from oxidative damage, inhibit cancer cell proliferation	Nassourou *et al.*, 2016; Owuamanam *et al.,* 2014; Hachibamba *et al.* 2013; Haq *et al.*,2013; Gutiérrez-Uribe *et al.,* 2011; Onimawo and Asugo, 2004; Key *et al.*,2004

Active constituents	**Functional properties**	**Physiological effects**	**References**
Resistant starches and Dietary fiber	Antidiabetic	Slow release of glucose in to the system (low glycemic index)	Onyeka, 2007
	Hypocholesterolemic	Depletion of bile acids from the circulation, promotes cholesterol conversion into additional bile acids, increase excretion of fecal fat	Perera *et al.,* 2016; Frota *et al.,* 2008; Kahlon and Shao, 2004
Cowpea proteins, Isolates and peptides	Anticancer	Selective cytotoxic activity against a wide range of cancer cell lines	Tian *et al.,* 2013; Joanitti *et al.,*2010
	Antidiabetic	Cowpea protein isolates mimic the action of insulin, inhibit dipeptidyl peptidase IV activity	Marya *et al.,* 2018; Barnes *et al.,* 2015; Rocha *et al.,* 2014
	Antihypertensive	Inhibition of ACE	Leon *et al.,* 2013; Campos *et al.,* 2010; Guang and Phillips 2005
	Hypo-cholesterolemic	Functions via bile acid-binding and disruption of cholesterol micelles in the gastrointestinal tract, as well as by altering hepatic and adipocytic enzyme activity and gene expression of lipogenic proteins, which can modulate the lipid profiles. Inhibits HMG-CoA reductase activity; inhibits the expression of NPC1L1 and transcription factor SREBP2 The lysine/arginine ratio has been directly associated with lowering serum cholesterol levels	Marques *et al.,* 2018; Marques *et al.,* 2015; Frota *et al.,* 2015; Frota *et al.,*2010; Frota *et al.,*2008

2.3.4 Processing

Soaking is done as primary processing at household level for pulses. Taiwo and co-workers (1997) noted that soaking of cowpea prior to cooking had an effect only on the cookability, while the amount of water absorbed and the penetration depth (a measure of texture) of a penetrometer head in the seeds increased with cooking time. The properties were differed notably according to the varieties. Splitting in cooked beans increased with cooking time and ranged between 63% to 92% split.

Kushwaha *et al.* (2014) conducted a study on incorporation of cowpea flour at the levels of 20%, 40%, 60% and 80% to products made from whole wheat flour in *khajure*, semolina in halwa and refined wheat flour in *mathri*. Products prepared without cowpea flour served as control. Cowpea flour incorporation levels of 20%, 40% and 20% for *khajure*, *mathri* and halwa, respectively, was found to be significantly acceptable. Nutrient composition of acceptable cowpea supplemented food products show an increase in protein, fibre, calcium, iron, magnesium and zinc content ranging from 5.3-13.0%, 0.4 -1.5 %, 16.1-89.2%, 1.3-5.5%, 31.8-98.4% and 0.7-1.8%, respectively as compared to their control counterparts. In an another study on composite flour of cowpea and wheat to produce cake and evaluated sensorially based on ranking for preference. Hundred percent (100%) wheat flour cake was used as control. The composite flour with proportion 50%:50% cowpea: wheat baked at 200 ^{o}C produced the most preferred cake which was significantly higher ($P < 0.05$) in terms of taste (7.22±2.01) and overall acceptability (7.03±1.82) when compared with the taste (6.67±1.84) and overall acceptability (6.80 ±1.81) of the control (Akosua *et al.*,2015)

Another study conducted by Mune, *et al.*,(2013) on cowpea protein concentrate prepared by isoelectric precipitation. The concentrate contained 86.90 % of the flour total protein, and had 85.82 % protein. Sugars and ash were in lower contents in the concentrate compared to the flour, while Fe and Zn contents were not significantly ($p> 0.05$) different. In vitro protein digestibility was high (86.81-88.74 %), and had a balanced essential amino acid composition. Tryptophan and total sulphur amino acids were first and second limiting amino acids. The predicted protein efficiency ratio, essential amino acids index and biological value indicated the good quality of cowpea protein concentrate, although elimination of tryptophan and sulphur rich proteins during protein extraction affected the chemical score and protein digestibility corrected amino acid score.

Traditionally in West Africa, Akara is made from fresh cowpea paste seasoned with hot peppers, onion and salt and then deep-fried at 193ºC (Plahar *et al.,* 2006).

Moutaleb *et al.,* (2017) evaluated cowpea and sweet potato based akara and evaluated for nutritional and functional properties. Moisture, protein, fat, ash, and carbohydrate were in the range of 7.33 to 9.75, 11.66 to 20.98, 1.51to3.49, 2.48 to 2.73, and 65.38 to 76.28% respectively. Water and oil absorption capacities ranged between 1.64 and 2.52 and, 1.67 and 2.04g/g, respectively. Bulk density and water solubility ranged between 0.86 and 0.90g/mL, and 1.19 to 2.01g/100g respectively. Lowest swelling power was recorded for cowpea flour while the highest value was observed for the composite cowpea-sweet potato (50-50%) flour. The overall acceptability of the akara sensory properties was the 90-10% composite. Huse *et al.,* (2006) modified the akara by incorporating soybean flour at 0, 3, 6 and 9 % in cowpea flour. The akara made from a 94% cowpea and flour/6% soy flour blend plus edible coatings (of Methylcellulose) absorbed 26% less oil during frying than akara made from 100% cowpea. Soy-substituted akara was firmer than freshly fried, 100% cowpea (control) akara.

Popped sorghum, baked cowpeas and baobab (Adonasia Digitata L) fruit pulp powder were blended in five different formulations (45:55:0; 50:45:5; 55:35:5; 55:35:10; 60:25:15; 65:15:20) to produce ready-to-eat (RTE) snack bars. Crude protein in the formulations ranged between 11.38±0.35 g/100 g and 21.35±0.89 g/100 g), total fat content ranged between 2 ± 0.03 and 3.26±0.13 while crude fiber ranged between 1.59±0.12 g/100 g and 2.76±0.02 g/100 g. The carbohydrate content of the RTE snack varied significantly between 61.1 ± 3.32 g/100 g and 73.25±0.31 g/100 g while the energy content ranged between 1502.71±43.7 KJ and 1524.06±30.47 KJ. A significant increase in vitamin C concentration between 8.76±0.49 g/100 g and 21.16±2.03 g/100 g with increasing baobab content was observed. Iron concentration of the snack ranged between 4.34±1.80 g/100 g and 5.76±1.78 g/100 g while Zinc concentration (1.65±0.35 g/100 g and 2.76±0.14 g/100 g) was statistically different between the formulations. The sensory evaluation of the product revealed that color, taste, texture, aroma, appearance and overall quality were in acceptable range with mean scores of above 5 (Momanyi *et al.,* 2020).

Pelembe *et al.,* (2002) developed a protein rich composite Sorghum-Cowpea porridge by extrusion cooking at 130^{o}C and water content of 200 g/kg and was similar to commercial instant maize–soy porridge in terms of functional properties. Increase in cowpea resulted in increase in protein content, water absorption index (WAI) and decrease in Expansion ratio (ER).

2.3.4 Food Safety, Awareness and Practices

Food-borne related illnesses have increased over the years, and negatively affected the health and economic well-being of many developing nations (WHO, 2007). As per FERG Report 2010, annual burden of foodborne diseases in the WHO South-East Asia Region includes more than 150 million illness, 175 000 deaths and 12 million Disability Adjusted Life Years (Havelaar *et al.,* 2015). The WHO South East Asia Region has a quarter of the world's population, diarrhoeal diseases continue to be one of the top three leading causes of daily losses. It has the second highest burden of food-borne diseases per population among WHO regions. Each year worldwide, unsafe food causes 600 million cases of foodborne diseases and 420 000 deaths. 30% of foodborne deaths occur among children under 5 years of age. WHO estimated that 33 million years of healthy lives are lost due to eating unsafe food globally each year, and this number is likely an underestimation (World Health Organization, 2015).

Food poisoning occurs as a result of consuming food contaminated with microorganisms or their toxins, the contamination arising from inadequate preservation methods, unhygienic handling practices, cross-contamination from food contact surfaces, or from persons harbouring the microorganisms in their nares and on the skin (Barrie, 1996; Jay *et al.,* 1999). Unhygienic practices during food preparation, handling and storage creates the conditions that allows the proliferation and transmission of disease causing organisms such as bacteria, viruses and other food-borne pathogens (Fielding *et al.,*2001; Gent *et al.,*1999). Kabiru and Madaki (2017), studied candies microbiological quality of locally-made candies sold in selected primary schools. The microbes identified from the samples were *Staphylococcus aureus, E. coli, Salmonella species* and *Shigella species.* The microbial contamination may be due to contamination from the candy producers, vendors or the raw materials used. The fungal isolates identified from the sweet samples were *Rhizophus species* and *Aspergillus niger,* their occurrence may be due the high sugar concentrations of the candies which favors the growth of the fungi. The presence of these microbes serves as potential health risk to the general population at large.

Lack of food safety awareness among the workers resulted in high microbial loads. In a few studies, the Critical Control Points (CCPs) for deterioration of the quality of food was identified as coliform contamination from the hands of the food handlers and this was reduced drastically when the food handlers used soap to wash their hands (Gupta, *et al.*,2011).

The Integrated Disease Surveillance Programme (IDSP) network was launched in India in 2004. Aggregate analysis of IDSP data from 2011-15 shows food-borne outbreaks together with acute diarrhoeal diseases constitute nearly half of all reported outbreaks under IDSP for the period 2011-16 (fig 2.3).

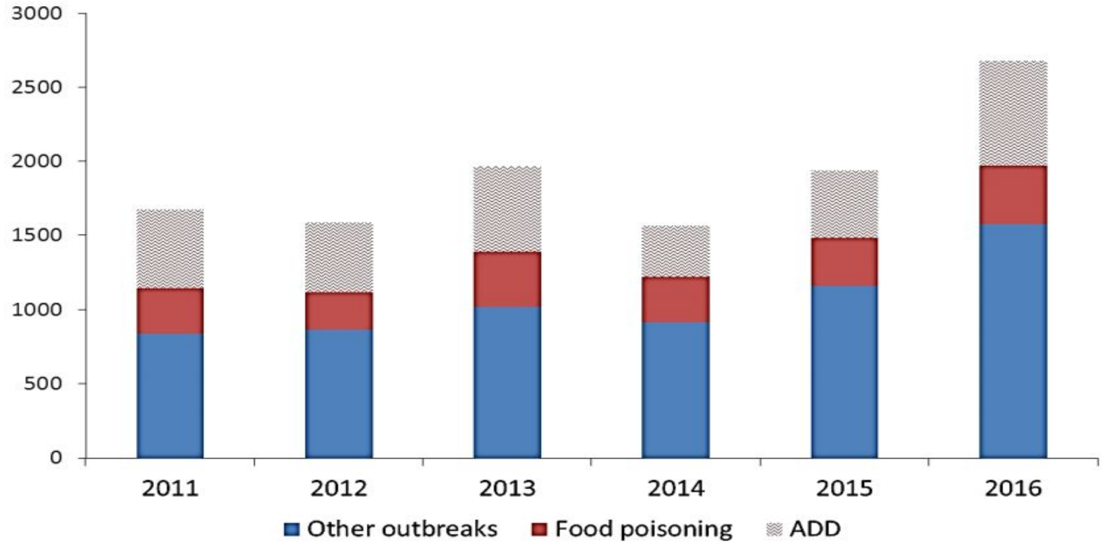


Figure 2.3: Food born outbreaks in India 2011 to 2016

Food may become contaminated during food production and processing or during food preparation and handling, or during storage. At food production and processing contamination of food is by the infected individuals, cross contamination and inadequate cooking temperature. The food safety and standards authority of India has taken several steps to contain the rise of noncommunicable diseases including suitable labelling of food items for class title, saturated fats, trans fats; downward revision of trans fat level in partially hydrogenated vegetable oils from 10% to 5% (NCDC, 2017).

CHAPTER III

MATERIAL AND METHODS

Present study was undertaken on agribusiness module of value-added underutilized food products towards livelihood support of hills population. This chapter highlights the research design and methodology followed during the investigation. The study was undertaken in phases wherein, each consecutive phase was dependent on the earlier phase. The detail description of this is given below.

Part I

- 3.1 Selection of Under Processed Food Products
  - 3.1.1 Locale of study
  - 3.1.2 Period of study
  - 3.1.3 Selection of food item for further study
- 3.2 Development of Value-added Products from Ginger
  - 3.2.1 Procurement of raw material
  - 3.2.2 Selection of recipes
  - 3.2.3 Primary processing
  - 3.2.4 Standardization of the developed ginger products
  - 3.2.5 Selection of ginger products for nutritional and storage study
- 3.3 Nutritional Evaluation of the Selected Ginger Products
  - 3.3.1 Proximate content
  - 3.3.2 Mineral content
  - 3.3.3 Antioxidant estimation
    - 3.3.3.1 Total phenolics content
    - 3.3.3.2 Total flavanoid content
    - 3.3.3.3 DPPH assay
- 3.4 Need assessment of Ginger Processed Products Among Farmers

- 3.5 Perception of Vendors About the Processed Ginger Products
- 3.6 Techno- Economic Aspect of the Developed Ginger Products

Part II

- 3.7 Shelf Life Evaluation of the Selected Ginger Products
    - 3.7.1 Sensory evaluation of the stored ginger candy/ toffee and sherbet
    - 3.7.2 Microbial load of the stored ginger candy/ toffee and sherbet
    - 3.7.3 TSS and pH of the stored ginger sherbet
    - 3.7.4 Moisture content of ginger candy/ toffee
- 3.8 Development of Value-added Products from Cowpea
    - 3.8.1 Procurement of raw material
    - 3.8.2 Selection of recipes
    - 3.8.3 Standardization and sensory evaluation of the cowpea products
    - 3.8.4 Selection of cowpea products for further nutritional and storage study
- 3.9 Nutritional Evaluation of Cowpea Products
    - 3.9.1 Proximate content
    - 3.9.2 Minerals (Calcium and Iron)
    - 3.9.3 DPPH assay
- 3.10 Shelf life Evaluation of the Selected Cowpea Products
    - 3.9.1 Sensory evaluation of the products
    - 3.9.2 Moisture content
    - 3.9.3 Peroxide value
    - 3.9.4 Temperature and relative humidity
- 3.11 Statistical Analysis

Part III

3.12 Training Conducted for Empowerment and Employment Generation of Women and Farmers

  3.11.1 Organization of training programme

  3.11.2 Registration of trainees

3.13 Technological Out of the Trainings

3.14 Development of Module for Establishing Food-based Agribusiness

3.1 Selection of Under Processed Food Products

3.1.1 Locale of study: The study was conducted at Department of Foods and Nutrition of College of Home Science, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

3.1.2 Period of study: This study was undertaken during August 2017 to December 2020.

3.1.3 Selection of food items for further study: Relevant studies conducted under various departments such as Department of Foods and Nutrition, Department of Food Science and Technology and Department of Horticulture of the GB Pant University of Agriculture and Technology were screened. After 450 research projects and on the basis of production, availability of raw material, nutritional and medicinal properties two crops i.e. ginger and cowpea were selected for the product formulation.

3.2 Development of Value-added Products from Ginger

3.2.1 Procurement of raw material: Ginger was procured from the local market of Pantnagar in a single lot. Other raw materials were also purchased from the local market.

3.2.2 Selection of recipes: Children don't like ginger due to its pungency. Hence keeping its pungent flavour of the ginger in view sweet recipes were tried for product formulation. Sweet products such as ginger juice, ginger candy and ginger toffee were tried from the ginger.

3.2.3 Primary processing: Fresh raw ginger was selected and dipped in water for 1 hour. Then the soaked ginger was scrubbed with hand and washed thoroughly with several changes of water to made it free from dirt and dust. The washed ginger was peeled and again washed. This cleaned and washed ginger was utilized for the product development.

3.2.4 Standardization of the developed ginger products: Selected recipes were standardized for their ingredients, amounts and method of preparation. The products developed were initially assessed for their acceptability by the panel members. For evaluating the products for its sensory qualities viz. color, taste, texture, flavor, appearance and overall acceptability, score card was developed. Nine-point hedonic scale suggested by Swaminathan (1987) was used for rating of the sensory attributes for each of the product (Annexure I). Coded samples were subjected to sensory evaluation after 24 hours of the production. A glass of water was served to avoid intermingling of the taste of two recipes and ensure proper evaluation. Overall, 30 semi trained panelist have evaluated the developed products. Scores were awarded for colour, texture, flavour, taste and overall acceptability. All the panel members were asked to assign scores to indicate their preference for the product.

3.2.4 Selection of ginger products for nutritional and storage study: On the basis of sensory evaluation and ease in production two ginger products were selected for the nutritional evaluation and storage study.

3.3 Nutritional evaluation of the selected ginger products

3.3.1 Proximate content: Following parameters were analysed in the selected ginger products.

a. Moisture content: The moisture content of the samples were determined by using AOAC, (1999) method. Ten grams of each sample was weighed and kept in oven for removal of moisture at 50 to 55 ^{o}C for 12 hours. After cooling the sample were reweighed. The process of heating and cooling was repeated till constant weight was obtained. The moisture per cent was calculated using following formula.

$$\text{Moisture per cent} \quad \frac{\text{Initial weight} - \text{Final weight}}{\text{Weight of samples}} \text{ x } 100$$

b. **Protein:** Protein content was estimated by determining the nitrogen present in the sample using Micro kjeldhal method AOAC, (1999).

Principle: Micro kjeldhal nitrogen distillation method is used to determine the protein content of food stuffs by estimating the nitrogen content of the material and multiplying nitrogen value by 5.26 (general factor). The nitrogen present in protein or any other organic material is converted to ammonium sulphate by sulphuric acid in the presence of a catalyst during digestion. This salt, on steam distillation liberates ammonia which is collected in boric acid solution. Ammonia forms a loose compound, ammonium borate with boric acid and titrated against standard acid.

Reagents Required: Digestion mixture (98 parts K_2SO_4 + 2 parts $CuSO_4$), 40 per cent NaOH, 10 ml H_2SO_4, Two per cent Boric acid, 0.1N HCl and Methyl red indicator.

Procedure: Three hundred milligram of moisture free sample was digested with 0.3g of digestion mixture (K_2SO_4 + $CuSO_4$) and 10ml of concentrated H_2SO_4 till the contents became clear. The digested sample was then diluted with 50 ml distilled water and the mixture made alkaline by adding 40ml of NaOH (40 per cent). The ammonia liberated on distillation was collected in a conical flask containing 25ml of 4 per cent boric acid and two drops of indicator.

The contents were titrated against 0.1N standardized HCl. A reagent blank was also run simultaneously. The titrated value of blank was subtracted from the value obtained for the sample to get true titrated value. The nitrogen content was calculated as follows:

The protein content of the sample was obtained by multiplying the nitrogen with a factor 6.25.

$$\text{Nitrogen (g/100g)} = \frac{\text{(Sample reading - Blank reading) x (Normality of HCl x 14)}}{\text{Weight of sample taken (g)}} \times 100$$

c. **Fat**: The fat content of all the selected samples were estimated by using the method of AOAC, (1999). Pelican’s Socs Plus system was used for fat analysis.

Principle: Fats and fatty acids are the esters of glycerol. Oil from food is solubilized in petroleum ether and then distilled off completely to estimate the crude fat in the sample.

Reagents Required: Petroleum ether (40 – 60 ^{o}C) – 80 ml.

Procedure: One gram of sample was taken in a thimble. The material was extracted with petroleum ether for 2 hours without interruption by gentle heating in a soxhlet apparatus. Extraction flask was then cooled, and ether was removed by heating and weight was taken. The fat content was expressed in gram per 100 gram of the sample.

$$\text{Fat}\ \ \text{g/100g}\qquad \frac{\text{Final weight of flask - initial weight of flask}}{\text{Weight of sample taken}}\qquad 100$$

d. Ash: Ash content of the samples was determined by the method suggested by AOAC, (1999).

Principle: The ash of the food stuff is the inorganic residue remains after burning of organic matter. Ash of samples is alkaline in nature while meat and cereals have acidic ash. Alkaline ash is due to the presence of salts or organic acids that are converted to carbonates during ashing. Estimation of total ash is an index of refinement of foods and a useful parameter of nutritional value of foods.

Procedure: Five grams of moisture free sample was weighed in previously heated, cooled and weighed crucible. Sample was then completely charred on the hot plate, followed by heating in muffle furnace at 600 ^{o}C for 3- 4 hours. The crucible was cooled in a desiccator and weighed. The process was repeated till constant weights were obtained and the ash was almost white or grayish in colour. Ash content of samples was calculated using following formula:

$$\text{Ash}\ \ \text{g/100g}\qquad \frac{\text{Weight of ash}}{\text{Weight of sample taken}}\qquad 100$$

e. Fiber: The fiber content was estimated by acid alkali digestion method as suggested by AOAC, (1999).

Principle: Crude fiber is a loss on ignition of dried residue remaining after digestion of sample with 1.25 per cent sulfuric acid and 1.25 per cent sodium hydroxide solutions under specific conditions. During the acid and subsequent alkali treatment, oxidative hydrolytic degradation of the native cellulose and considerable degradation of lignin occur. The residue obtained after final filtration is weighed, incinerated, cooled and weighed again. The loss in weight gives the crude fiber content.

Reagents Required: Sulphuric acid (1.25 per cent) – 200 ml, Sodium hydroxide (1.25 per cent) – 200 ml, Alcohol and ether.

Procedure: Five gram of fat free dried and powdered sample was boiled with 200 ml of 1.25 per cent sulphuric acid for thirty minutes. It was filtered through a muslin cloth and washed with boiling water and again boiled with 200 ml of 1.25 per cent sodium hydroxide for thirty minutes. Again, it was filtered through a muslin cloth and wash with hot distill water till free from alkali, finally wash with alcohol. The residue was transferred to a pre-weighed crucible and dried, cooled and weighed. The residue was then ignited for 2 to 3 hrs in a muffle furnace at 600 ^{o}C, cooled in a desiccator and reweighed. The fiber content of the sample was calculated from the loss in weight on ignition and expressed in percentage.

$$\text{Crude fiber (g/100g)} = \frac{100 - \left(\text{moisture} + \text{fat content of sample}\right) - \text{Weight of fibre (g)}}{\text{Weight of the sample (g)}} \times 100$$

f. **Carbohydrate:** Carbohydrates content was determined by subtracting from 100 the sum of the values (per 100 g) of moisture, crude protein, fat, ash and crude fiber AOAC, (1999). Formula for determining total carbohydrates content was:

Carbohydrate (g/100g) = 100 – (crude fiber + ash + protein + fat)

g. **Energy:** The energy value of sample was calculated using physiological fuel value per gram of protein, fat and carbohydrate respectively AOAC, (1999).

Energy (kcal/100g) = (per cent protein x 4) + (per cent carbohydrate x 4) + (per cent fat x 9)

3.3.2 Mineral content: Minerals viz. Calcium, iron, zinc, magnesium, manganese and chromium were estimated among all the selected samples through Atomic Absorption Spectrophotometer (AAS) method suggested by Bishnoi and Brar, (1988).

Procedure: One gram of powdered moisture free sample was weighed and transferred in digestion tube. Ten ml. of digestion mixture i.e. 5ml perchloric acid and 5ml nitric acid was added in the tube and leave overnight. Next day the digestion tubes were kept on digestion rack for heating. Heating was continue till the particles were completely digested and clear. After the digestion, tubes were removed from the rack, cooled and volume was made up to 50ml with deionized water. After volume make up the solution was transferred to acid wash polythene bottles and stored for estimation of following minerals.

Atomic absorption spectrophotometer is the determination of concentration of a substance by the measurement of absorption of the characteristic radiation by the atomic vapor of an element. When radiation characteristics of a particular element, absorption of radiation occurs in proportion to the concentration of the atoms in the light path. The source of characteristics radiation was a hollow cathode lamp, the cathode being made of the element desires to be estimated.

$$\text{Mineral element} \;\; \text{ppm} \qquad \frac{\text{Mineral} \;\; \frac{\text{g}}{\text{ml}} \;\; \text{x dilution factor}}{\text{Weight of sample} \;\; \text{g}}$$

3.3.3 Antioxidant estimation

3.3.3.1 Total phenolics content: Gallic acid is a polyphenolic compound and can be used for the quantitative estimation of total phenolics by method of calibration curve equivalent factor with the help of UV spectrophotometer at 795 nm (Ayurvedic pharmacopoeia of India, 2011).

Reagent required: Methanol, DD water, Folin-Ciocalteau reagent, Sod. Carbonate and Gallic acid Reference standard.

Preparation of Standards: Stock Solution: Weight 10mg of Gallic acid and mix in 10 ml of Methanol and take out 1 ml of above solution in 10 ml volumetric and make up to 10 ml with methanol to get the final concentration of 0.1 mg/ml. Dilutions: From stock make at least five diff. dilutions Take 0.2, 0.4, 0.6, 0.8 and 1 ml of stock and diluted as below procedure.

- Take above stated different stock concentrations in the 25 ml of volumetric flask.

- Add 10 ml of dist. Water and 1.5 ml of Folin-Ciocaltaeu reagent.
- Keep it for 5 mins.
- Add 4 ml of 20% Na2CO3 solution.
- Make up the volume with dist. Water up to 25 ml.
- Keep it for 30 mins in dark then take the absorbance at 765 nm at UV spectrophotometer.

Procedure for Sample:

- Make the extract of the crude drug that may be aqueous, hydro-alcoholic or methanolic and then dry it properly to get residue.
- Take the dried extract of 1mg/ml concentration in the 25 ml of volumetric flask.
- Add 10 ml of distilled Water and 1.5 ml of Folin-Ciocaltaeu reagent.
- Keep it for 5 mins.
- Add 4 ml of 20% Na2CO3 solution.
- Make up the volume with dist. Water up to 25 ml.
- Keep it for 30 mins then take the absorbance at 765 nm at UV-Vis spectrophotometer.

Calculation- The amount of total phenolic was calculated by using the standard curve of Gallic acid drawn within a concentration range of 8.0 x 10^{-4} to 4.0 x 10^{-3} mg/ml having R2 value 0.996 and was expressed as mg Gallic acid equivalents /g (mg GAE/g) sample.

3.3.3.2 Total flavonoid content: The total flavonoid content in methanol extract was determined using aluminium trichloride method protocol described by Chang *et al.* (2002) with slightly modification. Briefly, 2 ml of 2 % aluminium trichloride solution in methanol was mixed with the 2 ml of a diluted stock solution (0.01 or 0.02 mg/ ml). Absorption readings were taken at 415 nm (ECIL spectrophotometer) after 10 min against a methanol blank, Quercetin was used as the standard. The total flavonoid content was determined using a standard curve of Quercetin drawn within a concentration range of 4.0 x 10^{-3} to 2.0 x 10^{-2} mg/ml having R2 value 0.998 and was expressed as mg Quercetin equivalents/g sample (mg QE/g sample)

3.3.3.3 DPPH assay: The free radical scavenging activity was measured by using 2, 2-diphenyl-1-picryl-hydrazyl (DPPH) by the modified method of McCune and Johns, (2002).

Principle: The main characteristic of an antioxidant is its ability to trap free radicals. Highly reactive free radicals and oxygen species are present in biological systems from a wide variety of sources. These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative disease. Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydroperoxide or lipid peroxyl and thus inhibit the oxidative mechanisms that lead to degenerative diseases. Various antioxidant activity methods have been used to monitor and compare the antioxidant activity of foods. These analytical methods measure the radical scavenging activity of antioxidants against free radicals like the 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical

Reagents Required: The reagents used for the study were 2,2-diphenyl-1-picryl-hydrazyl (DPPH), methanol, obtained from Merck or sigma. All reagents used were of analytical grade.

Extraction method: The dried powder of samples was extracted individually by cold percolation method (Parekh and Chanda, 2007) using methanol to determine the antioxidant activity. Ten g of dried powder was taken with 100 ml of methanol in a conical flask, plugged with cotton wool and then kept on a rotary shaker at 120 rpm for 24 h. After 24 h, the extract was filtered with eight layers of muslin cloth; centrifuged at 5000 rpm for 10 min. Supernatant was collected and the solvent was evaporated and the dry extract was stored at 4ºC in air tight bottles.

Procedure: The DPPH (2,2-diphenyl-1-picrylhydrazyl) is a free radical reagent and an easy, precise, and accurate method for the analysis of free radical scavenging activity of the food product. The 2,2-diphenyl-1-picryl-hydrazyl produces a violet solution in alcohol. It is reduced in the presence of an antioxidant molecule. Antioxidant activity of the methanol extract of the developed products and standard were assessed on the basis of the radical scavenging effect of the stable 2,2-diphenyl-1-picrylhydrazyl hydrate radical (DPPH). The diluted working solutions of the test samples were prepared in methanol. Gallic acid was used as the standard in solutions ranging from 5 x 10^{-4} to 4 x 10^{-3} mg/ml. DPPH solution 0.135 mM was prepared in methanol. Then 2 ml of this DPPH solution was mixed with 2 ml of sample solutions (ranging from 1 mg/ml to 8 mg/ml) and the standard solution were tested separately. These solution mixtures were kept in the dark for 30 min and optical density was measured at 517 nm using ECIL make spectrophotometer against methanol. 2 ml of methanol with 2 ml of DPPH solution was used as control. The optical density was recorded and percentage of inhibition was calculated using the formula (Saxena *et al.*, 2015 and Shimada *et al.*, 1992) given below:

$$\% \text{ of inhibition of DPPH activity} = (A–B/A) \times 100$$

Where, A is optical density of the control and B is optical density of the sample.

The free radical scavenging activity of the methanolic extracts of the test samples were expressed as the IC 50 value (mg/ml) i.e., the concentration necessary to decrease the DPPH concentration by 50%.

3.4 Need assessment of Ginger Processed Products among farmers

A survey was conducted among the 43 farmer women in Bhimtal, Nanital District of Uttarakhand. The area for study was selected on the basis of ginger production data and feasibility for follow-up of these farmers. The respondents were selected randomly from Lamjal, Bhurjala and Suryajal villages from Bhimtal. Structured questioner was prepared and all the respondents were interviewed for reliable data (Annexure II). The questionnaire was divided into three parts viz. General information of the respondents, ginger production, it’s utilization and perception on ginger processed products and skills.

3.5 Perception of vendors about the processed ginger products

The survey study was conducted among small vendors at Pantnagar, Negla and nearby areas, Udham Singh Nagar, Uttarakhand. Selection of respondent was done on the basis of the willingness of vendors to be part of the study as well as feasibility of the researcher. Structured questioner was prepared to assess awareness, acceptance and willingness of shopkeepers' to sell ginger products (Annexure III). Total 38 small vendors were surveyed. Packed ginger sherbet and ginger candy was shown to small vendor. Ginger products were given to small vendors for organoleptic acceptability and perception of the small vendors about the products.

3.6 Techno- economic aspect of the developed ginger products

Processing cost of the developed ginger product was evaluated. Hence for the cost calculation of processing of ginger sherbet and candy was done. All the hidden charges i.e. gas, electricity, labour charges was added (except the building rant) and expanse on machinery (if any) was also added to calculate the expanses.

3.7 Shelf life evaluation of the selected ginger products

The selected two ginger product were stored for 180 days (6 months). The following parameters were analysed at the interval of 30 days:

3.7.1 Sensory evaluation of the products: For storage study one juice treatment and one ginger candy treatment was further study for changes taken place on sensory parameter. The score card was similar as discussed under heading 3.2.3. Overall, 15 semi trained panellist were evaluated the selected products at the interval of 30 days. Ginger juice was packed in 200 ml of glass bottles and stored at room temperature. The bottles were opened at a regular interval for analysis. The selected ginger candy/ toffees were packed in plastic container (75 gm in weight) at ambient condition. At every 30th day a fresh bottle was opened for sensory and quality evaluation.

3.7.2 Microbial load of the stored ginger candy/ toffee and sherbet

(a) Total palate count: The selected ginger juice and ginger candy were analysed on 0 (fresh) day, 30th, 60, 90, 120 150 and 180 day for total plate count and yeast mould count. The samples were analyzed in three replicates.

Sterilization of glasswares: All the glasswares used in microbiological work were of Borosil make. Prior to start of experiment, the glasswares were sterilized in the hot air oven at 180ºC for 2 hours (Busta *et al.,* 1976).

Preparation of peptone water: For the analysis, peptone water was used for preparing dilutions. Peptone water was prepared by dissolving 0.1g of peptone and 0.5 g of NaCl in 100 ml distilled water (pH 7.2). After preparing solution, it was sterilized by autoclaving at 121ºC (15 lbs pressure) for 15 minutes and then cooled to 45 ºC before use.

Preparation of sample dilutions: Ten g of sample was blended with sterilized 0.1per cent peptone water and volume was made up to 100 ml with the same solution. This constituted first dilution (1:10). The suspension was then shaken thoroughly by hand shaking for 2 minutes and subsequent dilutions were made using sterilized 0.1 per cent peptone water. One ml of this suspension was aseptically transferred to 9.0 ml of sterilized 0.1 per cent peptone water tube, thus making 10^{-2} dilution (1:100). In the same fashion, dilutions of 10^{-3}, 10^{-4}, 10^{-5} and 10^{-6} were prepared.

Preparation of plates: Plates were prepared by pour method. Appropriate dilutions of the sample (1 ml) were transferred aseptically to sterile petri plates in duplicate and mixed well with 10-15 ml of presterilized plate count agar at 45 ºC. After solidification, plates were incubated at 37 ºC for 48 hours in bacteriological incubator.

Quantification of colonies: On completion of incubation period, petri plates were taken out of the incubator and the colonies were counted using colony counter. The dilution plates showing the number of colonies in the statistical range of 30-300 were selected and average of the counts were determined. The total plate count per g or ml of the sample was calculated using formula given below:

$$\text{cfu per g/ ml of sample} = \frac{\text{Number of colonies} \times \text{dilution factor}}{\text{Amount of sample taken}}$$

(b) Estimation of Yeasts and Mold counts

Yeast does not cause food poisoning but some type are capable of causing food spoilage. Molds can produce mycotoxines, which can affect adversely. Molds spores can be carried by wind hence have easy entry to a food. Yeast mold count (YMC) of the stored ginger juice and ginger candy was determined using standard plate count method given by APHA (1984) was estimated in ginger candy and sherbet by using the standard method suggested by

Counting colonies: Count colonies, multiply by the inverse of the corresponding dilution and report as yeast or mould count per gm or mL

Yeast and Mould count = x/gm or mL

3.7.3 TSS and pH of the stored ginger sherbet: In ginger juice, total soluble solids (TSS) ^{o}B and pH in juice was estimated by using the digital equipment at the interval of 30 days.

3.7.4 Moisture content of ginger candy/ toffee: This was evaluated in ginger candy. At every 30th day a fresh plastic bottle was opened and evaluated for moisture content as described under point 3.3.1 (a)

3.8 Development of value-added products from Cowpea

3.8.1 Procurement of raw material and primary processing: Cowpea variety Pant Lobia- 1 was procured from Vegetable Science Research Center, GB Pant University of agriculture and Technology, Pantnagar, Uttarakhand. The variety was selected on basis of recommendation of scientist from Vegetable Science Research Center. Other raw material such as black soybean, yellow soybean, Bengal gram flour, peanuts, refined oil, spices etc. were purchased from the local market of Pantnagar. All the raw materials were procured in a single lot.

The cowpea seeds and other raw material were cleaned thoroughly and made free from dust, dirt, spoilt grains, stone and other foreign matter. Cowpea seeds were divided into two parts and one part was ground into flour of mesh size of 70 and other part was kept as whole.

3.8.2 Selection of recipes: Salty products were formulated by using the cowpea seeds and the cowpea flour. On the basis of common and popular snacks in market as well as known to the general population total six products were selected. These cowpea products were *boondi, sev, papad,* enrobed nuts, roasted nuts and fried nuts.

3.8.3 Standardization and sensory evaluation of the developed products: Selected recipes were standardized for their ingredients, amounts and method of preparation. The products developed were initially assessed for their sensory evaluation.

The organoleptic evaluation of the developed products was done at nine point Hedonic rating scale (from dislike extremely to like extremely). Coded samples were subjected to sensory evaluation after 12 hours of the production. Overall 13 semi trained panellist were evaluated the developed products. Scores were awarded for colour, texture, flavour, taste and overall acceptability (heading 3.2.3).

3.8.4 Selection of cowpea products for further nutritional and storage study: On the bases of sensory evaluation four products were selected to study the storage of the developed products.

3.9 Nutritional evaluation of cowpea products

3.9.1 Proximate composition: The proximate composition of the developed cowpea products was analysed as described under heading 3.3.1. The nitrogen factor was 6.25 for evaluation of the protein content of the developed products.

3.9.2 Mineral content: The selected cowpea products were evaluated for calcium and iron content. The method of these minerals was similar as stated under the heading 3.3.2.

3.9.3 DPPH assay: For the assessment of antioxidant potential of the developed cowpea products was done through DPPH assay (as detailed under heading 3.3.3.3)

3.10 Shelf life evaluation of the selected cowpea products

3.10.1 Sensory evaluation of the stored cowpea products: The selected cowpea products were packaged in flat pouch bag aluminium foil film liner moisture proof zipper sealed bags (130 mm x 205 mm). The packets were of 75 gm in weight and kept in a plastic container at ambient condition. These products were stored for 100 days and at every 20th day a fresh packet was opened for sensory evaluation as described under heading 3.2.3. The evaluation of the stored products was done by13 semi trained panellist.

3.10.2 Moisture content: At every 20th day a fresh packet was opened and evaluated for moisture content as described under heading 3.3.1 (a)

3.10.3 Peroxide value: This is an indication of the extent of oxidation suffered by oil. Hence this was evaluated after 100 days of the storage of the developed cowpea products (AOAC, 1999).

Reagents required:

- Acetic acid - chloroform solvent mixture (3: 2). Mix 3 volumes of glacial acetic acid with 2 volumes of chloroform.
- Freshly prepared saturated potassium iodide solution: N and 0.01 N sodium thiosulphate solutions. Weigh 25 gm of sodium thiosulphate and dissolve in 1000 mL of distilled water. Boil and cool, filter if necessary. Standardise against standard potassium dichromate solution.
- Starch solution - 1% water-soluble starch solution

Procedure: Weigh 5 gm (±50 mg) sample into a 250 mL stoppered conical flask. Add 30 mL acetic acid chloroform solvent mixture and swirl to dissolve. Add 0.5 mL saturated potassium iodide solution with a Mohr's pipette. Let stand for one minute in dark with occasional shaking, and then add about 30 mL of water. Slowly titrate the liberated iodine with 0.1 N sodium thiosulphate solution with vigorous shaking until yellow colour is almost gone. Add about 0.5 mL starch solution as indicator and continue titration shaking vigorously to release all I2 from chloroform layer until blue colour disappears. If less than 0.5 mL of 0.1 N sodium thiosulphate is used repeat using 0.01 N sodium thiosulphate. Conduct blank determination (must be less than 0.1 ml 0.1 N sodium thiosulphate).

Calculation: Peroxide value expressed as milliequivalent of peroxide oxygen per kg sample (meq/kg):

Peroxide value = Titre x N x 1000

Weight of the sample

Where,

Titre = mL of Sodium Thiosulphate used (blank corrected)

N = Normality of sodium thiosulphate solution.

Fresh oils usually have peroxide values well below 10 meq/kg. A rancid taste often begins to be noticeable when the peroxide value is above 20 meq/kg (between 20 – 40 meq/Kg). In interpreting such figures, however, it is necessary to take into account the particular oil or fat.

3.10.4 **Temperature and relative humidity:** During storage temperature and relative humidity on the day when the packets were opened for sensory evaluation was also recorded. Observation were taken with the help of digital devices.

3.11 Statistical analysis:

One-way analysis of variance (ANOVA) was applied to determine significant differences between means, with the significance level taken at ($P<0.05$). Statistical analysis of data was performed using WASP (Web Agri Stat Package) software version 2.0.

Part III

3.12 Training conducted for empowerment and employment generation of women and farmers

3.12.1 **Organization of training programme:** Training programmes on the selected developed value-added products of ginger and cowpea were organized with the help of KVK Jolikot, Nanital and KVK Sitarganj, Udham Singh Nagar. Training programmes were organized in the form of demonstrations on value added product development. Awareness was created through lectures on nutritional and health benefits of these foods.

3.12.2 **Registration of trainees:** Registration form was developed to register the trainees (Annexures IV). With the help of these forms the trainees were traced and explored for their interest for the setup of the very small-scale business. In training programmes food safety and security issues were also discussed with the upcoming entrepreneurs.

3.13 **Technological out of the trainings:** The technological output was recorded in terms of adoption of the processed products and sale these products in market. For facilitation of these budding entrepreneurs (if any), marking tips and place were also provided at various fairs such as *kisan meal,* provided stall during nutrition week in the department of Foods and Nutrition and at various other places after linking them with KVK and SHGs'.

3.14 Development of module for establishing food-based agribusiness

Trainees' concerns and quarries observed during initial training programmes were noted in point. Based on the trainees' concerns and needs, module was finalized for the establishment of food processing-based agribusiness.

CHAPTER IV

RESULT AND DISCUSSION

The present study was undertaken on "Agribusiness module of value-added underutilized food products towards livelihood support for hills population". The results of the study are presented under the following headings.

Part I

4.1 Development of ginger products and sensory evaluation of the products

4.2 Nutritional evaluation of the selected ginger candy and sherbet

  4.2.1 Proximate

  4.2.2 Minerals

  4.2.3 Antioxidant

4.3 Shelf life evaluation of the selected ginger candy and sherbet

  4.3.1 Sensory evaluation of the stored ginger candy and sherbet

  4.3.2 Microbial load of the stored ginger candy and sherbet

  4.3.3 TSS and pH of the stored ginger sherbet

  4.3.4 Moisture content of ginger candy

4.4 Need assessment of Ginger Processed Products among farmers

  4.4.1 General information of the farmers

  4.4.2 Ginger production and its utilization by theses farmers

  4.4.3 Perception about the ginger products

  4.4.4 Cost assumption of ginger products

4.5 Perception of vendors about the processed ginger products

4.6 Techno- economic aspect of the selected ginger products

Part II

4.7 Development and sensory evaluation of the cowpea products

4.8 Nutritional evaluation of the selected cowpea products

  4.8.1 Proximate

    - 4.8.2 Minerals
    - 4.8.3 Antioxidant
- 4.9 Shelf life evaluation of the selected cowpea products
    - 4.9.1 Sensory evaluation of the cowpea products
    - 4.9.2 Temperature and relative humidity
    - 4.9.3 Moisture content of the cowpea products during storage
    - 4.9.4 Peroxide value of the developed products

Part III

- 4.10 Training conducted for employment generation
- 4.11 Impact of the technology transferred and trainings imparted
- 4.12 Development of module for establishing food-based agribusiness

Part I

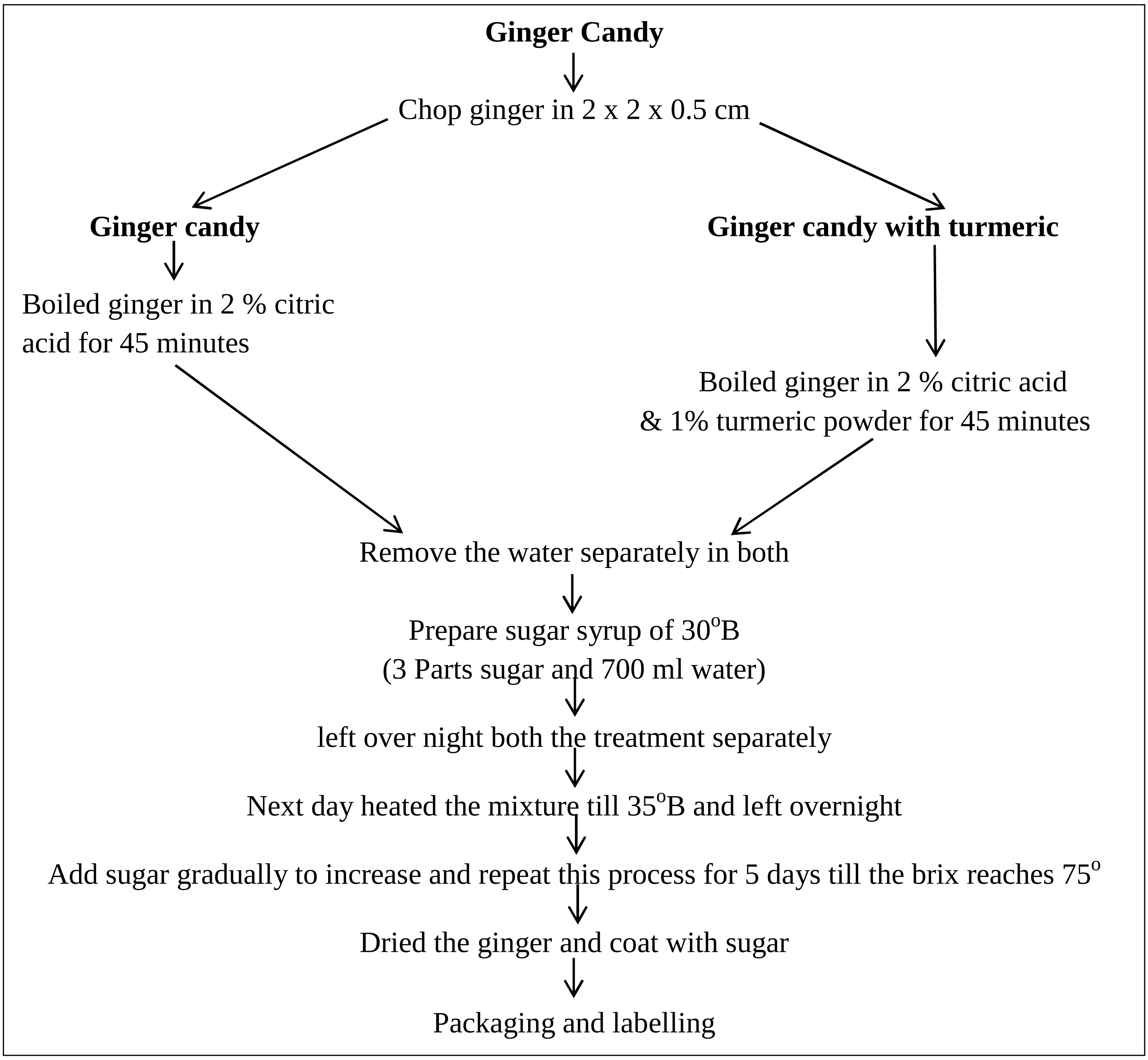
4.1 Development of Ginger Products and Sensory Evaluation of the Products

Various permutation combinations of ginger products were tried in the food processing laboratory at College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar. Different trials for ginger candy development were employed by using lime, brine solution and sodium chloride. After trials for formulation of ginger candy, sherbet and toffee were selected for further study. The detailed step for primary processing of ginger for product formulation are presented under the flow chart 4.1.

Tender fresh ginger was selected
↓
Dipped in water for 1 hour
↓
Scrubbed with hand and washed thoroughly
↓
Washed ginger was peeled and again washed

Flow Chart 4.1. Primary processing of raw tender ginger

Ginger candy: Various trails were made to finalize the ginger candy. These variations were in the size, boiling solution of chopped ginger and the taste of the final ginger candy. Two finally selected ginger candy processing steps are presented under the flow chart 4.2. The mean sensory scores of the developed ginger products are presented under table 4.1.


Ginger Candy
Chop ginger in 2 x 2 x 0.5 cm
Ginger candy
Ginger candy with turmeric
Boiled ginger in 2 % citric acid for 45 minutes
Boiled ginger in 2 % citric acid & 1% turmeric powder for 45 minutes
Remove the water separately in both
Prepare sugar syrup of 30°B (3 Parts sugar and 700 ml water)
left over night both the treatment separately
Next day heated the mixture till 35°B and left overnight
Add sugar gradually to increase and repeat this process for 5 days till the brix reaches 75°
Dried the ginger and coat with sugar
Packaging and labelling

Flow Chart 4.2. Ginger candy processing steps

Preliminary results were revealed that only ginger candy and ginger candy with turmeric were accepted. The analysis of variance (ANOVA) was performed for color, flavor, texture, appearance and overall acceptability of sample. For ginger candy treatments, the significant difference was observed in colour and appearance of the ginger candy and ginger candy with turmeric. These results reveal that the natural colour of ginger candy was preferred over colour of turmeric ($p \leq 0.05$). However, both the candy treatments were liked by the panel members. For appearance, ginger candy scored 7.75 and ginger candy with turmeric scored 6.75 and varied significantly at $p \leq 0.05$. This revealed that natural colour of the ginger was liked by the panelist.

Table 4.1: Mean sensory scores of ginger candy

Ginger Candy				
	Ginger Candy	**Ginger Turmeric candy**	**CV**	**CD**
Colour	$7.92^{a}\pm0.127$	$6.89^{b}\pm0.195$	9.229	0.349
Flavour	$7.47^{a}\pm0.168$	$7.16^{a}\pm0.156$	11.104	NS
Texture	$7.39^{a}\pm0.172$	$7.28^{a}\pm0.206$	12.706	NS
Taste	$7.59^{a}\pm0.215$	$7.28^{a}\pm0.192$	14.776	NS
Appearance	$7.75^{a}\pm0.156$	$6.75^{b}\pm0.185$	10.510	0.389
Over all Acceptability	$7.73^{a}\pm0.157$	$7.25^{a}\pm0.191$	13.307	NS

± Standard deviation
Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$
CV- Coefficient of variation, CD-critical difference, NS – non-significant

Figure 4.1 depicts the hedonic rating of the panel members and noted that ginger candy (GC) was extremely liked by 10.00 %, liked very much by 43 % of the respondent.

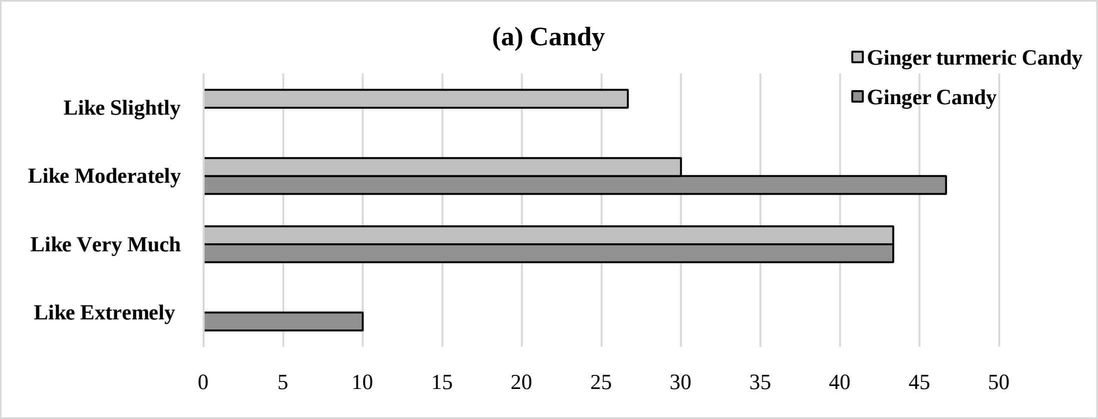
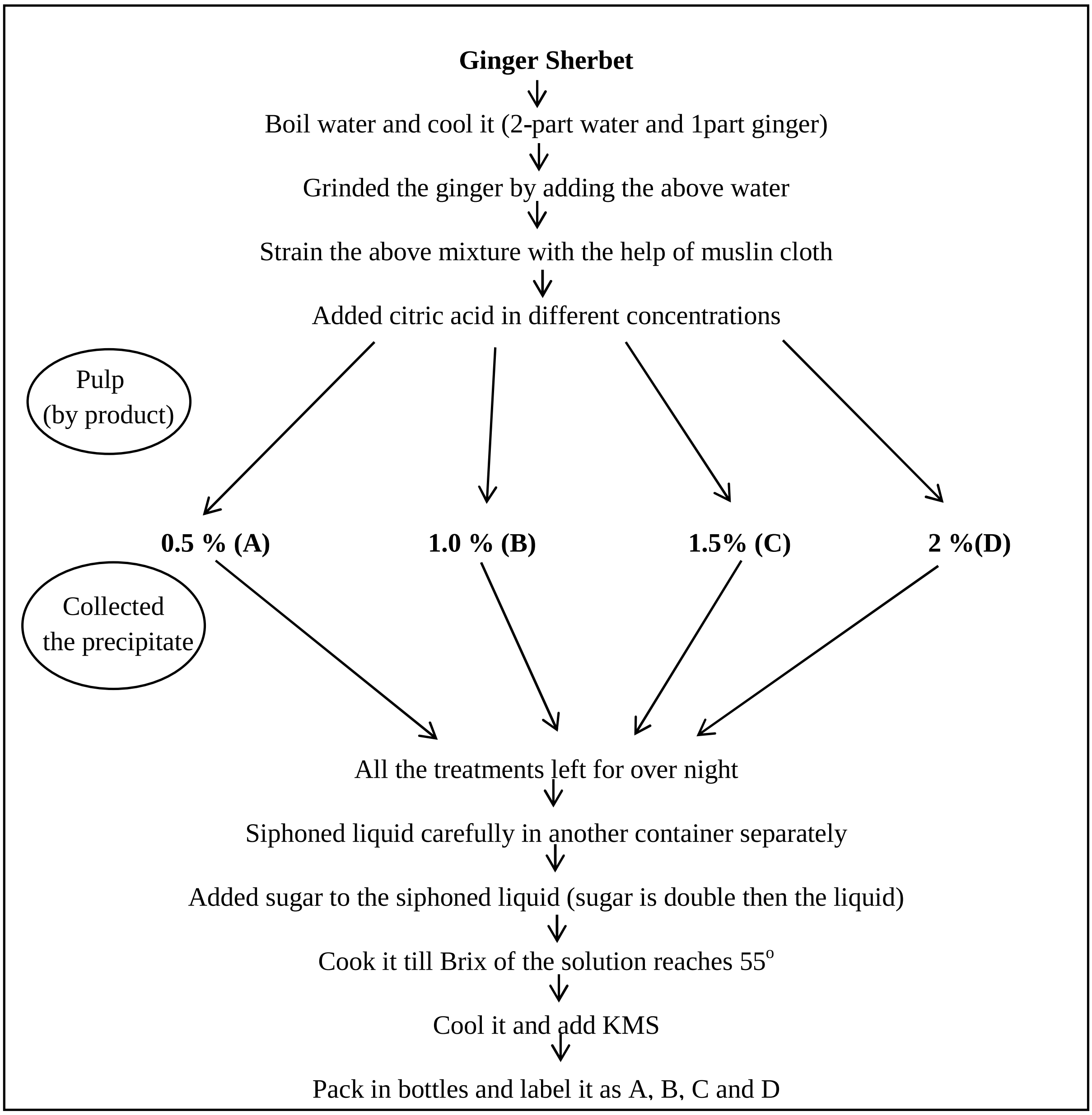


Figure 4.1: Hedonic rating of the developed ginger candy

Ginger Sherbet: Ginger processing for various trials for sherbet making was done. Ginger sherbet was developed by using different concentrations of the citric acid (D). The detailed steps for ginger processing are present in flow chat 4.3.


Ginger Sherbet
Boil water and cool it (2-part water and 1part ginger)
Grinded the ginger by adding the above water
Strain the above mixture with the help of muslin cloth
Added citric acid in different concentrations
Pulp (by product)
0.5 % (A)
1.0 % (B)
1.5% (C)
2 %(D)
Collected the precipitate
All the treatments left for over night
Siphoned liquid carefully in another container separately
Added sugar to the siphoned liquid (sugar is double then the liquid)
Cook it till Brix of the solution reaches 55°
Cool it and add KMS
Pack in bottles and label it as A, B, C and D

Flow Chart 4.3. Ginger sherbet processing steps

It was observed that with increase in percentage of the citric acid, the colour of the sherbet was turned into bright pink. Sherbet treatment with 2% of citric acid (D) was significantly high in terms of flavour and overall acceptability. This was extremely liked by the 26.67% of the respondents (Figure 4.2).

Similar results were also observed by Hariharan and Mahendran (2016). They had developed ginger-lime RTS and reported that increase in lime juice concentration from 2 % to 10 % significantly affect colour, pungency, taste and overall acceptability.

Table 4.2: Mean sensory scores of ginger sherbet

	Ginger Sherbet					
	A	**B**	**C**	**D**	**CV**	**CD**
Colour	7.50^{a}±0.213	7.67^{a}±0.209	7.63^{a}±0.164	7.82^{a}±0.160	9.400	NS
Flavour	7.20^{a}±0.222	7.57^{ab}±0.214	7.82^{b}±0.162	7.83^{b}±0.180	11.460	0.447
Texture	7.25^{a}±0.223	7.47^{a}±0.195	7.42^{a}±0.118	7.60^{a}±0.141	10.044	NS
Taste	7.40^{a}±0.170	7.57^{a}±0.126	7.55^{a}±0.136	7.88^{a}±0.151	10.261	NS
Appearance	7.52^{a}±0.233	7.55^{a}±0.195	7.53^{a}±0.157	7.80^{a}±0.174	11.018	NS
Over all Acceptability	7.40^{a}±0.147	7.68^{ab}±0.121	7.73^{ab}±0.126	8.03^{b}±0.157	9.682	0.383

± Standard deviation
Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$
CV- Coefficient of variation, CD-critical difference, NS – non-significant

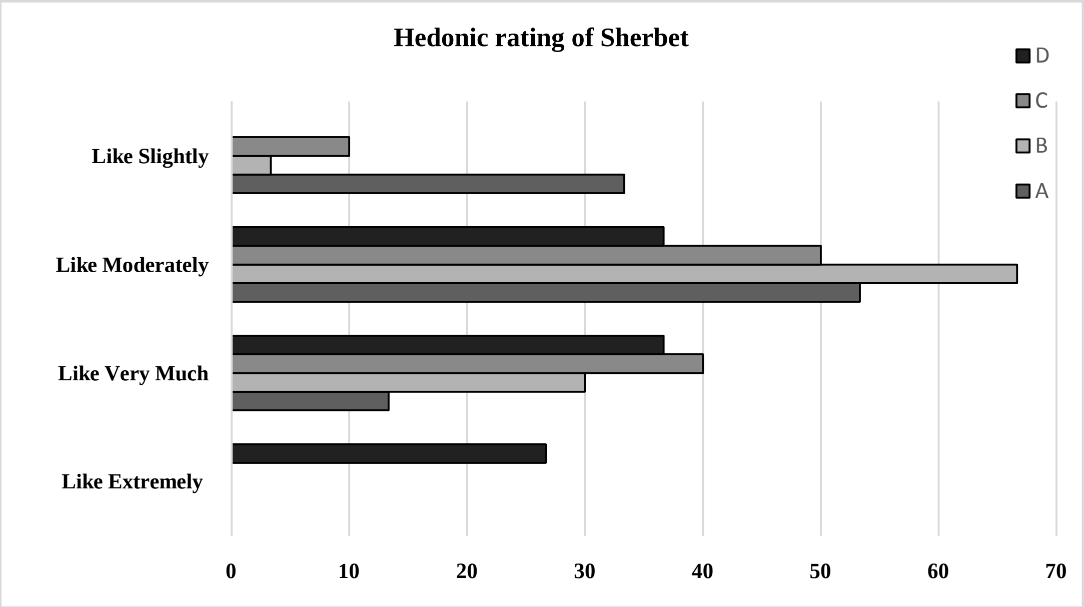
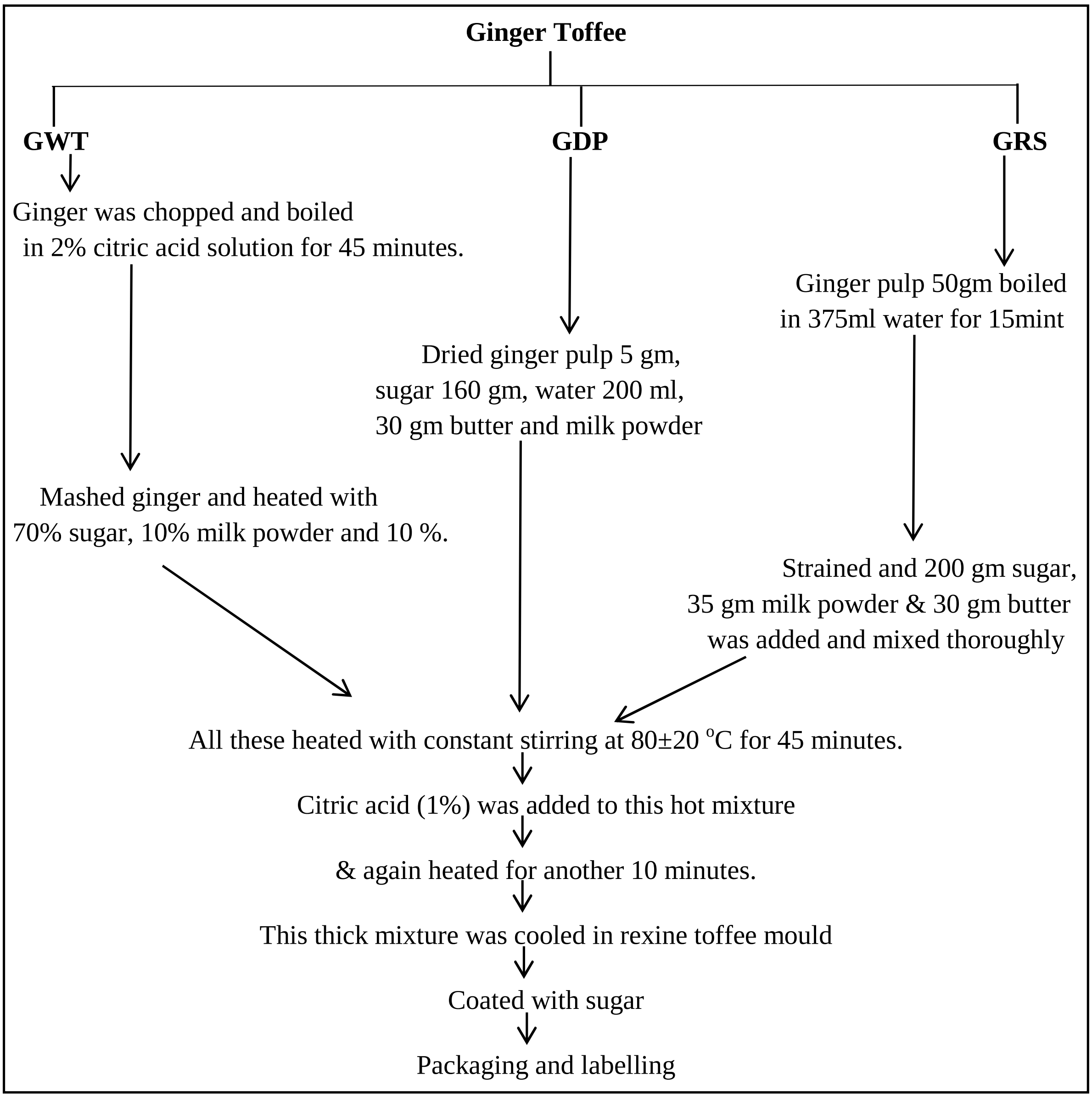


Figure 4.2: Hedonic rating of the developed ginger products Sherbet

Among all these products two products i.e. Ginger candy (GC) and Ginger Juice with 2% citric acid was further studied for nutritional composition along with mature ginger, tender ginger and precipitated salt obtained after the processing of ginger sherbet. Ginger toffee was developed with the objective to utilize the ginger pulp residue obtained after juice extraction. Hence all the toffee treatments were dropped for further study.

Ginger toffee: The processing steps for ginger toffee are presented in the flow chat 4.4.


Ginger Toffee
GWT
GDP
GRS
Ginger was chopped and boiled in 2% citric acid solution for 45 minutes.
Dried ginger pulp 5 gm, sugar 160 gm, water 200 ml, 30 gm butter and milk powder
Ginger pulp 50gm boiled in 375ml water for 15mint
Mashed ginger and heated with 70% sugar, 10% milk powder and 10 %.
Strained and 200 gm sugar, 35 gm milk powder & 30 gm butter was added and mixed thoroughly
All these heated with constant stirring at 80±20 °C for 45 minutes.
Citric acid (1%) was added to this hot mixture
& again heated for another 10 minutes.
This thick mixture was cooled in rexine toffee mould
Coated with sugar
Packaging and labelling

Flow Chart 4.4. Ginger toffee processing steps

Results of ginger toffee made from whole ginger toffee (GWT) was liked by the panel member followed by Ginger dried Pulp (GDP) toffee and ginger pulp residue strained (GRS) toffee. The GWT was significantly high at 5% level of significance for flavour, texture and taste (table 4.3).

Table 4.3: Mean sensory scores of ginger toffee

Sensory parameters	**Ginger Toffee**				
	GWT	**GDP**	**GRS**	**CV**	**CD**
Colour	7.59^{a}±0.182	7.29^{a}±0.195	7.34^{a}±0.151	11.229	NS
Flavour	7.67^{a}±0.169	7.24^{ab}±0.146	6.83^{b}±0.222	13.316	0.508
Texture	7.28^{a}±0.216	6.24^{b}±0.162	6.72^{c}±0.166	12.441	0.442
Taste	7.69^{a}±0.165	7.00^{b}±0.184	6.98^{c}±0.176	12.713	0.483
Appearance	7.41^{a}±0.161	6.97^{a} ±0.213	7.31^{a}±0.223	13.346	NS
Over all Acceptability	7.91^{a}±0.141	6.71^{b}±0.182	6.90^{b}±0.132	10.633	0.401

± Standard deviation

Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$

CV- Coefficient of variation, CD-critical difference, NS – non-significant

Figure 4.3 depicts that the ginger whole toffee was extremely liked (20.00%) by the panel members at hedonic rating followed by ginger dried pulp toffee (3.33%). The GDP toffee had rough texture which was a limiting factor noted by the panel members. GRS has low ginger flavour and significantly less liked by the panel members with respect to GWT. However non-significant difference was observed with GDP for flavour.

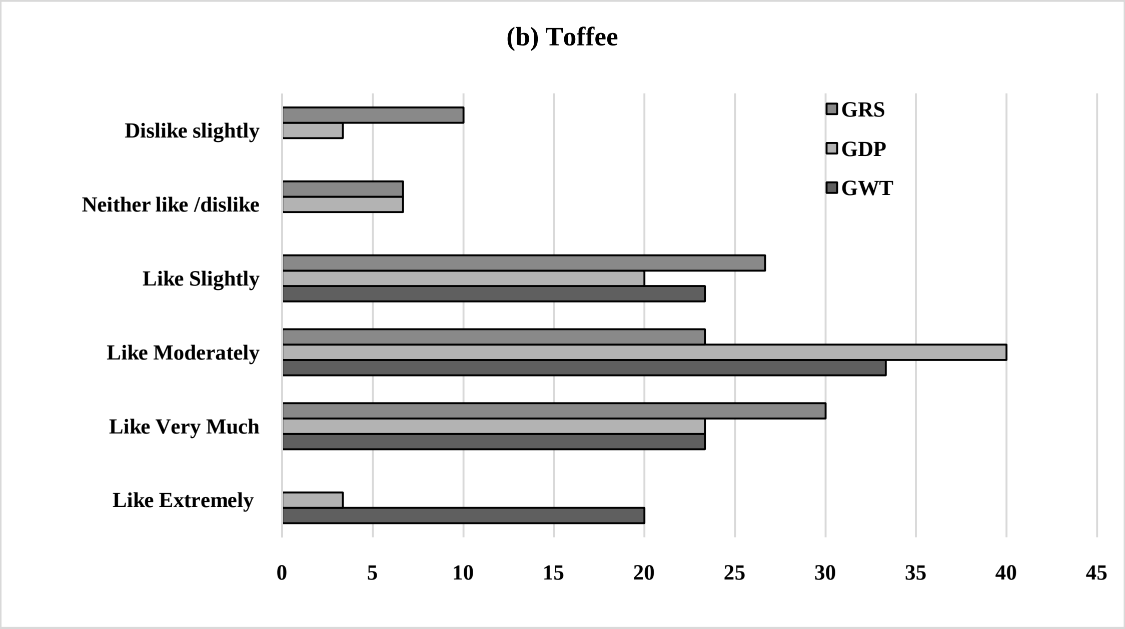


Figure 4.3: Hedonic rating of the developed ginger products toffee

4.2 Nutritional evaluation of the selected ginger products ginger products

4.2.1 Proximate composition: The data of chemical composition of tender ginger, mature ginger, ginger juice, ginger candy and ginger precipitate are presented in Table 4.4. The chemical composition of tender ginger was found as moisture 93. 40%, ash 3.80%, protein 2.65%, fat 3.80%, crude fiber 7.30%, and energy 338.80 kcal on dry weight bases. Results of present study revealed that with increase in maturity stage of ginger the moisture content and carbohydrate content was decreased. However, crude fiber, ach, crude fat and protein content were trend of increase. Khan *et al.*, (2016) anlysed powdered ginger also has nutritional components i.e. fatty oil (3–6%), protein (9%), carbohydrates (60–70%), crude fiber (3–8%), and about 8% ash. Whereas ginger candy was shown to contain 5.88 % moisture. Alam *et al.*, (2018) prepared ginger candy and observed moisture 7.04%, ash 0.78 %, fat 0.18%, fiber 1.60 % and protein 2.78.

Ginger precipitate was obtained after adding citric acid in the extract of ginger while its processing for juice. This precipitate was also analysed and observed that it contained higher amount of protein (7.04%) and ash (5.67%.). This precipitate could be utilized for the coating of candy as it was observed hygroscopic in nature.

Table 4.4: Proximate composition of ginger and its products (%/100gm).

	Moisture	Ash	Fat	Fiber	Protein	CHO	Energy (Kcal)
Tender Ginger	93.40 ± 0.034	3.80 ± 0.014	3.80 ± 0.151	7.30 ± 0.058	2.65 ± 0.043	73.49 ± 0.195	338.80 ± 0.653
Mature Ginger	90.60 ± 0.126	7.48 ± 0.218	4.48 ± 0.099	9.75 ± 0.547	10.54 ± 0.113	67.75 ± 0.731	353.47 ± 1.781
Candy	5.88 ± 0.399	0.39 ± 0.013	3.96 ± 0.099	1.68 ± 0.107	0.55 ± 0.102	93.42 ±0.126	411.53 ± 0.918
Sherbet	41.86 ± 0.202	0.02 ± 0.002	0.03 ± 0.002	0.04 ± 0.002	0.19 ± 0.022	99.71 ± 0.022	399.95 ± 0.014
Precipitated residue/ Salt	9.37 ± 0.202	5.67 ± 0.121	0.07 ± 0.007	0.53 ± 0.011	7.04 ± 0.217	86.69 ± 0.352	375.59 ± 0.491

*dry weight bases.
± Standard deviation

4.2.2 Mineral content: The mineral composition of the tender ginger, mature ginger, ginger candy, ginger sherbet and ginger precipitate were estimated for calcium, magnesium, manganese, iron, zinc and chromium (table 4.5). The tender ginger noted higher for magnesium, manganese, iron and zinc content as compare to mature ginger. The iron and zinc content of the candy was noted 2.14 mg/100gm and 1.89 mg/ 100gm. All the analysed minerals were found maximum in ginger candy as compared to sherbet and ginger precipitate. The mineral and nutritional composition varies with the type, variety, agronomic conditions and various other processing and storage conditions (Agrahari, 2015).

Table 4.5: Mineral composition of the ginger and its products (mg/100gm).

Particulars	Calcium	Magnesium	Manganese	Iron	Zinc	Chromium
Tender Ginger	9.76±1.196	196.40±0.524	22.81±0.255	32.10±1.223	8.06±0.119	0.23±0.013
Mature Ginger	12.14±0.435	121.04±1.058	7.63±0.434	19.62±0.084	3.07±0.054	0.33±0.003
Candy	5.94±0.385	27.30±0.428	4.29±0.026	2.14±0.177	1.89±0.059	0.37±0.054
Sherbet	0.62±0.076	5.54±0.660	0.32±0.058	0.55±0.068	0.31±0.025	0.06±0.010
Precipitated residue/ Salt	2.10±0.054	10.21±0.741	0.83±0.031	3.01±0.237	1.31±0.112	0.28±0.015

*dry weight bases.
± Standard deviation

4.2.3 Antioxidant analyses:

The results for samples i.e. tender ginger, mature ginger, ginger candy, ginger sherbet and precipitate were analysed for total phenolic, flavonoids and DPPH assay and presented under the table 4.6. Total phenolics content was observed higher in mature ginger (5.53 mg GAE/g) followed by ginger precipitate (4.90 mg GAE/g) and tender ginger (3.09 mg GAE/g). The flavonoid content in the test samples were extract in methanol and ranged between 0.19 to 0.74 QE/g in ginger sherbet and tender ginger respectively. The (DPPH) radical scavenging activity with the IC50 value in tender ginger was 0.74 mg/mL followed by mature ginger (0.58 mg/100gm) and candy 0.39mg/g.

Table 4.6: Antioxidants present in the ginger and its by products

	Total polyphenol (GAE mg/g)	**Flavanoid (QE/g)**	**DPPH (IC_{50}) mg/ml**
Tender Ginger	3.0	0.74	19.28
Mature Ginger	5.53	0.58	7.29
Candy	0.22	0.39	8.71
Sherbet	0.11	0.19	9.37
Precipitated residue/ Salt	4.90	0.198	168.76

Li *et al* (2016) studied total phenolic content in fresh ginger and noted 8.46 mg GAE/g. Mukherjee and co-worker (2014) studied total phenolic content by using response surface methodology and concluded that solvent concentration, temperature and time had the most significant effect on the extraction rate of polyphenols.

4.3 Shelf life evaluation of the ginger products

The selected ginger candy (GC) and Ginger Juice with 2% citric acid was further studied for six month storage. Ginger toffee was developed with the objective to utilize the ginger pulp residue obtained after juice extraction. Hence all the toffee treatments were dropped for further study.

4.3.1 Sensory quality of the selected ginger products during storage:

Sensory evaluation of the products offers the opportunity to obtain a complete analysis the changes in the various properties of food as perceived by human senses during storage. Table 4.7 and 4.8 depicts the mean sensory scores of the products i.e. ginger candy and ginger juice with 2 % citric acid (D) stored for 180 days. Result reveals that non-significant difference was observed in both the stored products. The difference was non-significant was observed on sensory parameter for both the stored products. Similar results were obtained by Ahmad *et al.* (2016).

Ginger juice with 2 % citric acid (D) was found to be acceptable at nine-point hedonic rating scale by the panelist. Slight difference was recorded in terms of colour however, statistically it was non-significant. Ahammed *et al.*, 2014 studied the storage of ginger juice were carried out for four months at room temperature and observed at an interval of 30 days. This study indicated a good prospect of processing of ginger by juice.

Table 4.7: Effect of six months storage on sensory parameters of the selected ginger candy.

Ginger Candy							
Days	**0 Day**	**30 Day**	**60 Day**	**90 Day**	**120 Day**	**150 Day**	**180 Day**	**CV**
Colour	8.46±0.133	8.39±0.197	8.50±0.174	8.14±0.185	8.07±0.165	8.11±0.297	8.14±0.177	8.997
Flavour	8.29±0.163	8.25±0.201	8.14±0.082	8.11±0.077	8.18±0.100	8.07±0.049	8.00±0.117	5.805
Texture	8.25±0.114	8.21±0.155	8.21±0.125	8.18±0.113	8.07±0.071	8.07±0.127	8.04±0.036	5.123
Taste	8.18±0.145	8.32±0.207	8.39±0.197	8.14±0.110	8.04±0.123	8.25±0.215	8.21±0.255	8.522
Appearance	8.32±0.124	8.32±0.124	8.29±0.155	8.29±0.155	8.00±0.091	8.04±0.213	8.00±0.262	7.761
Pungency	8.32±0.124	8.25±0.146	8.25±0.114	8.11±0.093	8.07±0.071	8.07±0.071	8.07±0.127	5.211
Over all Acceptability	8.32±0.162	8.32±0.193	8.29±0.172	8.18±0.100	8.18±0.124	8.18±0.100	8.07±0.202	7.38

± Standard deviation

CV- Coefficient of variation

Table 4.8: Effect of six months storage on sensory parameters of the selected ginger sherbet.

Ginger Sherbet (D)								
Days	**0 Day**	**30 Day**	**60 Day**	**90 Day**	**120 Day**	**150 Day**	**180 Day**	**CV**
Colour	8.40±0.184	8.33±0.126	8.37±0.124	8.27±0.118	8.23±0.145	8.13±0.091	8.07±0.067	5.962
Flavour	8.37±0.124	8.23±0.108	8.33±0.187	8.17±0.116	8.13±0.091	8.10±0.072	8.13±0.103	5.685
Texture	8.23±0.108	8.13±0.103	8.17±0.093	8.10±0.072	8.13±0.124	7.97±0.124	7.93±0.161	5.642
Taste	8.07±0.108	8.07±0.161	8.13±0.210	8.17±0.116	8.25±0.122	8.33±0.126	8.27±0.137	6.853
Appearance	8.23±0.108	8.23±0.168	8.20±0.145	8.17±0.205	8.03±0.192	8.03±0.172	8.00±0.085	7.181
Pungency	8.00±0.213	8.07±0.161	7.93±0.175	7.80±0.200	7.93±0.145	7.93±0.248	7.63±0.251	10.064
Over all Acceptability	8.30±0.127	8.23±0.108	8.33±0.211	8.23±0.108	8.12±0.094	8.10±0.196	7.97±0.150	7.027

± Standard deviation
CV- Coefficient of variation

4.3.2 Microbial load of the stored ginger sherbet and candy products: The result of microbial count load in ginger candy and sherbet with 2 % citric acid (D) are presented under table 4.9. Total plate count was found in range between 0.27 x10^3 to 1.61 x10^4. In ginger sherbet least microbial load was recorded. The results of the microbial loads of the present study was observed in range suggested by FSSAI under the standards for fruits and vegetables cut or minimally processed and packed, including juices (FSSAI regulation, 2011).

Table 4.9: Microbial load and other parameters of the stored ginger products.

	Parameter	**0 Day**	**30 Day**	**60 Day**	**90 Day**	**120 Day**	**150 Day**	**180 Day**
Candy (GC)	**Total plate count** (cuf/g)	1.61 x10^4	0.27 x10^3	0.26 x10^4	0.38 x10^4	0.45 x10^4	0.45 x10^4	0.27x10^4
	Yeast & mold count (cuf/g)	1.32 x10^2	0.32 x10^2	0.77 x10^2	0.59 x10^2	0.73 x10^2	0.75 x10^2	0.73x10^2
Sherbet (J4)	**Total plate count** (cuf/ml)	<10	<10	<10	<10	<10	<10	<10
	Yeast & mold count (cuf/ml)	<10	<10	<10	<10	<10	<10	<10

4.3.3. TSS and pH of the stored ginger sherbet

The selected ginger candy and sherbet was also studied for the change in pH and TSS during the storage period and results are presented under the table 4.10. The pH of the selected ginger sherbet was ranged between 2.7 to 3.15. The pH had increasing trend till 90th day of storage. The got stabilized after slight fall. and TSS of the sherb*et al*so had recorded the similar trends. The TSS was noted almost similar till 90th days of storage and after 120th days it was decreased to 49.3. Similar results were recorded by Lal *et al*. (1999) during the six months of storage of ginger and apple based juice in pH and TSS.

Table 4.10: pH and TSS of the stored ginger sherbet.

Parameter	0 Day	30 Day	60 Day	90 Day	120 Day	150 Day	180 Day
pH	2.7	2.9	3.11	3.15	2.98	2.96	2.99
TSS	54.8	54.7	54.5	54.1	55.1	53.3	49.5

4.3.4. Moisture content of ginger candy

Change in moisture content of candy during storage of 180 days are presented under the figure 4.4. Moisture content of ginger candy ranged from 5.12 to 12.38 % during the 180 days of storage period. The remarkable change was noticed in terms of moisture after 150 days of preservation. Ahmad *et al*. (2016). conducted study to develop candy from fresh cherry (Pyrunus avium L.) for studying their storage life. Among different changes, moisture concentration was prominent during preparation of preserve and candy.

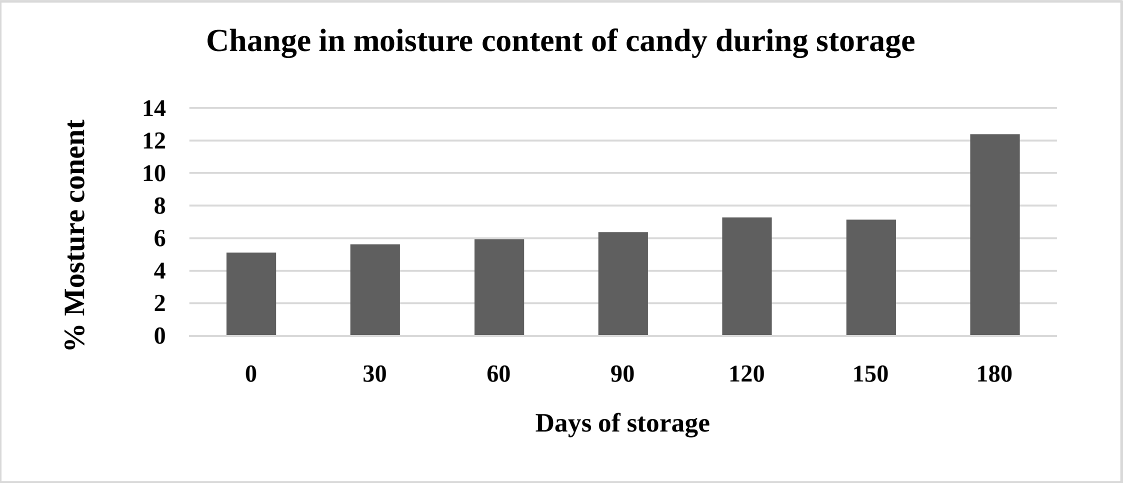


Figure 4.4: Change in moisture content of candy during storage

4.4 Need assessment of Ginger Processed Products among farmers

Survey was conduct to obtain the information about the perception of the farmers about these processed products. The obtained information was further divided into three parts and presented as follows:

4.4.1 General information: The data on general information (Table 4.11) revealed that 74 per cent of the respondents were female, young followed by middle and old aged. The average age of the respondent was 36.12 yr which was in range of the studies focus on entrepreneurs 35 to 45 yr (Bruhn and Zia, 2012; Premand *et al,* 2012). The education data showed that 50.0 per cent of the respondent was high school passed and 38 per cent was primary educated.

Table 4.11. General information, production and utilization of ginger by farmers of the studied area.

Sr. No.	Particular	Respondents General information	
		Frequency	Percentage
1	Gender		
	Male	13	26.0
	Female	37	74.0
2	Age		
	Young (up to 28 yr)	18	36.0
	Middle (29-38 yr)	15	30.0
	Late middle (39-48 yr)	7	14.0
	Old (49 yr and above)	10	20.0
3	Education		
	Primary	19	38.0
	High school/ intermediate	25	50.0
	Graduation	5	10.0
	Post Graduation or other	1	2.0
4	Occupation		
	Un employed	18	36.0
	Agriculture	22	44.0
	Employed (Gov./Privet sector)	6	12.0
	Student	6	12.0

4.4.2. Ginger production and utilization: It was observed that currently 74 per cent of the farmers were growing ginger (Table 4.13) and 24.32 per cent were growing below 50kg. In terms of ginger consumption it was noted that all the respondent were consuming ginger in tea followed by curry preparation (72.0%). During peak season, the selling prices of ginger ranged between Rs. 20/kg to 80/kg. All the prepared ginger products were liked very much by the farmer. The farmers were ready to prepare the products and sell them in market. Hence both products may help in increasing the farmers' income.

Table 4.12: Ginger production and its utilization by the famers.

Sr. No.	**Particular**	**Ginger production and its utilization by the respondent**	
		Frequency	**Percentage**
1	Grows ginger	37	74.0
2	Production of ginger		
	Below 50 kg	9	24.3
	50kg – 100kg	9	24.3
	100kg - 150kg	4	10.8
	150kg -200kg	4	10.8
	Above 200kg	11	29.7
3	Use of ginger		
	Self consumption	37	100.0
	For seed	33	89.1
	For sale	24	64.8
	Sent to relatives	19	51.3
4	Form of ginger consumption		
	Tea	50	100.0
	Vegetable	36	72.0
	Dried/*Sherbet*/Candy	0	00.0

4.4.3. Perception on ginger processed products:

4.4.3. Perception on ginger processed products: It was noticed that ginger products were liked extremely and too much by 26.0 per cent and 66.0 per cent of the respondent, respectively (Table 4.13) 84.0 per cent became interested to acquire training for ginger *sherbet* making.

Table 4.13: Perception of respondent on the processed ginger *sherbet*.

Sr. No.	Particular	Perception of respondent on the processed ginger *sherbet*	
		Frequency	**Percentage**
1	Liking of the products		
	Extremely	13	26.0
	Too much	33	66.0
	Like Moderately	4	08.0
2	Want to get training for ginger processing	42	84.0
3	Willingness to adopt as business	32	64.0
4	Knowledge of the regulatory bodies working for food products		
	Yes	11	22.0
	No	13	26.0
	No response	27	54.0

4.5 Perception of small vendors about the processed ginger products

Over all acceptability of the product by the small vendors is presented under the table 4.14. The over all acceptability of Ginger sherbet was liked maximum i.e. liked extremely (28.95 percent) followed by liked moderately. Results of organoleptic evaluation indicate that 76.32 per cent of the small vendors liked ginger sherbet. Total 81.58 per cent of the respondent liked ginger candy. Small vendors said that such kind of ginger products were new for them. The reason of not liking the product was that these vendors personally did not like ginger flavour and believed that this product could sell in winter only.

Table 4.14: Over all organoleptic score of ginger sherbet and ginger candy

Sensory Scores	Sherbet, n (%)	Candy, n (%)
4(Dislike moderately)	1 (2.63 %)	1 (2.63 %)
5 (Dislike slightly)	2 (5.26 %)	3 (7.89 %)
6 (Neither like nor dislike)	6 (15.79 %)	3 (7.89 %)
7 (Like slightly)	4 (10.53 %)	7 (18.42 %)
8 (liked moderately)	9 (23.68 %)	10 (26.32 %)
9 (Like very much)	5 (13.16 %)	7 (18.42 %)
10 (liked extremely)	11 (28.95 %)	7 (18.42 %)

The total 81.58 per cent and 84.21 per cent of small vendors were wanted to sell the prepared ginger sherbet and candy respectively. More per cent of small vendors were wanted to sell ginger candy as it doesn’t need further preparation. For sherbet it has to dilute further either in cold or hot water.

Maximum number (i.e. 84 per cent) of small vendors were did not like to prepare and sell both the products. Reason for not preparing and selling the product was majorly time constrain or other work (84.38 per cent). Other works were included house hold work, animal rearing etc. However 9.38 per cent of the shopkeepers were satisfied with present work. These vendors were selling different products such as *golgappas, tikki* and noodles etc. These vendors informed that *golgappas, tikki* and noodles etc are very much know and highly acceptable to the consumers. This was also observed that the small vendors were more concern about the acceptability of the products among other consumer as these products were new in market.

Soam and Hussain, 2011 conducted a survey in 25 states of India identified promising indigenous drinks. Manufacturing procedures of these drinks was community traditional knowledge. Product acceptability by the retailers and consumers was high, hence companies would be willing to invest in such products. One of the important issues to be addressed is benefit sharing with traditional knowledge holders and alleviation of their socio-economic condition.

4.4.4 Cost assumption by vendor for processed ginger products: Cost assumption by small vendors was also recorded. Primarily vendors said that the cost has to be calculated on the basis of inputs used in product formulation. Ready to serve (RTS) ginger sherbet could be sold at 15 to 35 Rs/ 200 ml of glass bottle. For 200 ml of sherbet cost estimated by vendors was ranged between 40 to 60 Rs/ bottle (Figure 4.5). However in market different squash are available in the packaging of 750 ml and the cost range between Rs 120 to 170. Cost of various popular brands of carbonated drinks were ranged between Rs. 90/ 2.25 litters to Rs. 30/600ml. These carbonated drinks are not good for health. Now a days costumer are more conscious for health and willing to consume healthy foods

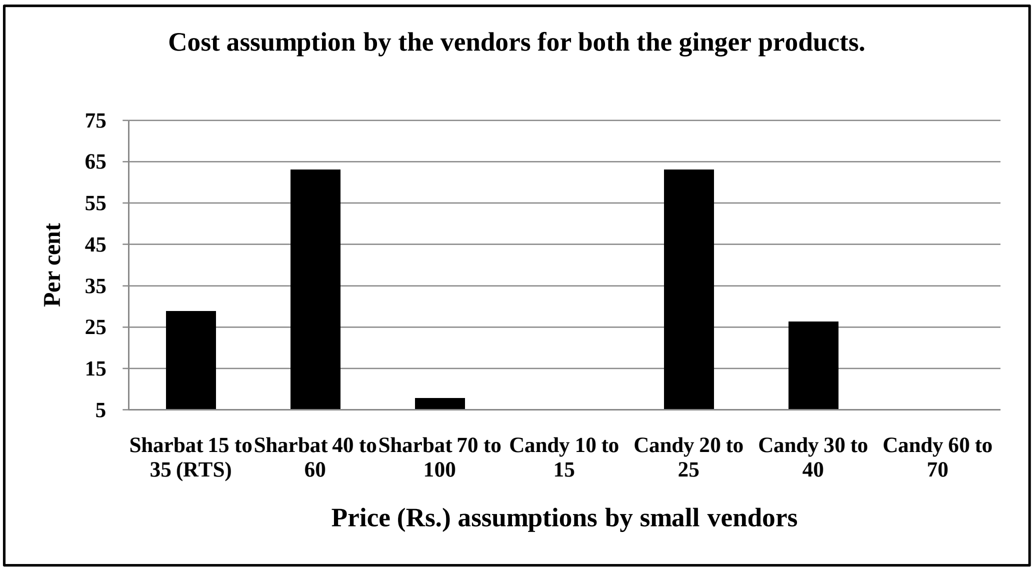


Figure 4.5: Cost estimated by the vendors for both the ginger products.

Providing employment opportunity to the people is the greatest task to the government. Therefore the people develop their entrepreneur skill to earn income for their livelihood. Street vending is one of the entrepreneurship, small in terms of capital and size and easy to start the business. Nonetheless, it is noticed that there has been a phenomenal increase in the number of street vendors leading to an increase in the number of workers in the informal sector in India and metro cities has witnessed for containing highest street vendors among all major cities in India. (Selvakumar *et al* 2014)

4.6 Techno- economic aspect of the developed ginger products

Formulation of ginger sherbet and candy was evaluated for techno-economic aspects. Expenditure on different parameters including direct and indirect cost except the rent of the building were included for cost calculation. Processing of ginger sherbet and candy were not required any expensive machinery hence it was also not included for the cost calculation.

The cost of hand operated business was calculated and present in table 4.15. For ginger sherbet one mixer grinder is required to extract juice form the ginger. In general this equipment is available at household level. However one another equipment is required i.e. cap crowning machine, for crowning of the ginger sherbet bottles. This equipment was made available to the producer at the time of packaging by the Department of food and nutrition, College of Home Science, GB Pant University of agriculture and technology. In sherbet processing it was noticed that in one very small scale enterprise or nano scale processing unit will accommodate two persons for unit operation. For candy processing it was observed that single person will required for the operation of preparation. Both the products manufacturing is 100 per cent profitable. Increment in production will required the equipment for peeling and other processing activities.

Table 4.15: Cost production of ginger sherbet and candy

Parameters	**Details for sherbet**	**Details for candy**
Assumption	25 working days in a month and one shift of 8 hours/day.	25 working days in a month and one shift of 8 hours/day.
Cost of raw material	Rs. 64,500/-	Rs. 3,000/-
Salaries/ wages of worker per month	Rs. 10,000/- (5,000 per person & 2 persons will be required)	Rs. 5,000/- (5,000 per person & 1 persons will be required)
Total Production	875 litters (packed in 200ml/bottle)	400 (packed in 50gm/ Packet)
Total Cost	Rs. 74,500/-	Rs. 8,000/-
Total turnover/ month	Rs. 1,49,000/-	Rs. 16,000/-
Net Profit per month	Rs. 74,500/-	Rs. 16,000/-

Capital investment in production and marketing of different processed food products is highest in building followed by machinery and equipment and land at an overall level of the units. There are various other variable factors such as size of land, type of machinery required for the processing of the food product (Singh, 2013; Paila 2009; Nagesh 1990). In production of any product, the total capital invested is direct related to the size of profit (Venkatasheshaiah, 1992).

The products have a sufficient niche market since per capita fruit juice consumption in India is only 20 ml. Market demand is expected to increase from 27.4 to 64 billion rupees by 2020 with 8.9 per cent market growth, with 65 per cent market share restricted to South India. The study offers for indigenous drinks registration and business strategy with sustainable rural livelihood development (Soam and Hussain, 2011)

Part II

4.7 Development of cowpea products and sensory evaluation of the products

Different permutation and combinations were employed for formulation of popular Indian fried snacks by using cowpea (Pant Lobia- 1) as base ingredient. The products made from cowpea flour and cowpea seeds were tried.

Preparation of *Boondi*: This is a popular deep fat fried Indian traditional snack food prepared from the Bengal gram flour batter with suitable consistency and is fried in small bolls through perforated ladle (Thangum 1965). For the present study 50 gm cowpea flour and 75 ml water was mixed to form batter (CPB). After keeping aside for 30 minutes and it was poured through perforated ladle over hot oil to make small balls/ drops. Control was prepared by replacing cowpea flour from Bengal gram flour (CoB).

Preparation of *sev*: It is small noodle shaped fried and crunchy snack popular in India made from Bengal gram flour dough containing pepper, chilli powder, turmeric and is relished for its texture and aroma. The thickness of these noodles varies. The hand operated stainless steel *sev* machine has six different disc templates. Control (CoS) was prepared by using Bengal gram flour- 50 gm, oil- 5ml, salt, spices, asafoetida powder, chilli powder and turmeric and water 20 ml. The dough was passed through the disc and deep fried. Cowpea *sev* (CPS) was prepared by replacing Bengal gram flour from cowpea flour.

Preparation of *papad*: *Papad* is a thin, circular shaped, fried wafer like product and normally made from pulse kernel flour with spices and other additives (Saxena *et al.* 1989)**.** Control was prepared by using Bengal gram flour (CoP), oil, black pepper, salt, asafoetida powder, *ajowan* seeds, chilli powder and turmeric powder. Test sample was prepared by using cowpea flour (CPP).

Preparation of enrobed nuts: Roasted peanut were coated with Bengal gram flour containing salt, asafoetida powder and chat masala powder. Three types of enrobed nuts were prepared. Control (CoE) was prepared by using Bengal gram flour 15gm, 1 gm arrowroot powder, salt, asafoetida powder, chat masala and 50 gm roasted peanuts. All these were mixed, 10ml water was added, mixed and fried. Two test enrobed nuts was prepare, one test sample was prepared by replacing Bengal gram flour (EA) and second one was prepared replacing arrowroot powder and Bengal gram flour completely (ECP).

Preparation of fried nuts: Control was prepared by using whole yellow soybean. The cowpea resembles with yellow soybean in appearance. The fried nuts were compared with both yellow (YFN) and black soybean (BFN). Soybean was soaked for 4 hours in lukewarm water and blanched for 20 minutes. Water was removed seeds were spread on blotting paper for 1 hour to remove extra water. After this seeds were fried, salt and chat *masala* was added to it. Cowpea fried nuts (CPFN) was prepared by soaking in lukewarm water for 1 hour and then blanched for 10 minutes then spread on blotting paper for 1 hour to remove extra water. After this, seeds were fried and in last salt and chat masala was added.

Roasted cowpea was hard in texture hence it was dropped. Hence s*ev, boondi, papad,* enrobed nuts (peanuts were enrobed by using cowpea flour with added spices) and fried cowpea nuts were further evaluated. After standardization and sensory evaluation flour products i.e. s*ev, boondi,* enrobed nuts (peanuts were enrobed by using cowpea flour with added spices) and fried cowpea nuts.

The mean sensory scores of the developed products are presented under table 4.16. The CPB *boondi* was at par at 0.05 % level of significance with CoB *boondi* in all the sensory attributes. Texture of CPB *boondi* was more crisp then the CoB *boondi*.

Cowpea *sev* (CPS) was comparable with CoS in all the sensory quality and was significantly better in texture. However, CoS *sev* had significantly high scores in terms of colour and appearance at 0.05 % level of significance.

Colour of the product also affects the appearance *papad* prepared by cowpea (CPP) was acceptable however CoP *papad* was liked very much by the panel members. The texture of CoP *papad* liked by the panel members and significantly higher then CPP at 0.05 percent level of significance. The colour of CPP *papad* was also light brown and that affected the appearance of the products. These all lead to decreased overall acceptability of CPP. However both the variations of *papad* were liked by the panel members.

Enrobed nut prepared by using 100% cowpea (ECP) was at par with Bengal gram flour enrobed nuts. The enrobed nuts prepared from cowpea and arrowroot powder (EA) was hard texture then ECP and CoE enrobed nuts. Overall acceptability of ECP had higher scores by the panel members due to its crunchy texture. Soybean fried nuts (YNF) and black soybean nuts (BFN) were varied significantly in terms of colour and appearance. The cowpea nuts (LFN) was at par with YNF fried nuts in terms of all the sensory parameters. All the three products were acceptable at nine point hedonic rating scale.

Bhagirathi *et al*., 1992 had developed *papad* by using two cowpea verities and black gram and reported that the cowpea *papad* were placed in liked very much and liked extremely categories. The quality of various products made from cowpea flour in different parts of world which are dependent on the functionality of cowpea flour; as influenced by processing technique, cowpea variety, particle size distribution of the flour, ingredients and the hydration pattern of the flour mixture (Appiah *et al*., 2011; Apea–Bah *et al*., 2016). Several other studies on therapeutic aspect of cowpea revels that the consumption of cowpea exerts protective effects against the development of several chronic diseases, such as gastrointestinal disorders (Trehan *et al*., 2015), diabetes (Rotimi *et al*, 2013; Barnes *et al*., 2015) and several types of cancer (Chon, 2013; Khalid and Elharadallou, 2013). With this, cowpea is also helpful in weight reduction (Perera *et al*., 2016), improve digestion and strengthen blood circulation (Trehan *et al*., 2015).

Table 4.16: Mean sensory scores of the products developed by using cowpea flour.

	Boondi				***Sev***				***Papad***			
	CoB	**CPB**	**CV**	**CD**	**CoS**	**CPS**	**CV**	**CD**	**CoP**	**CPP**	**CV**	**CD**
Colour	8.23^{a} ± 0.246	7.83^{a} ± 0.386	7.837	p>0.05	8.58^{a} ± 0.229	7.58^{b}±0.229	7.460	0.765	8.25^{a}±0.218	7.58^{b}±0.149	7.928	0.564
Flavour	8.00^{a} ± 0.246	7.92^{a} ±0.336	9.628	p>0.05	7.92^{a} ±0.288	7.50^{a} ±0.151	9.138	p>0.05	7.92^{a} ±0.229	7.46^{a} ±0.311	11.677	p>0.05
Texture	7.75^{a} ±0.305	8.17^{a} ±0.366	5.940	p>0.05	7.75^{a} ±0.351	8.08^{a} ±0.229	9.585	p>0.05	8.17^{a}±0.112	7.42^{b}±0.149	5.641	0.395
Taste	7.88^{a} ±0.315	7.92^{a} ±0.379	7.260	p>0.05	8.08^{a} ±0.229	7.92^{a} ±0.193	8.286	p>0.05	8.17^{a} ±0.207	7.58^{a} ±0.229	8.945	p>0.05
Appearance	7.83^{a} ±0.322	7.67^{a} ±0.376	7.612	p>0.05	8.25^{a}±0.179	7.63^{b}±0.186	6.881	0.491	8.08^{a}±0.149	6.83^{b}±0.112	4.288	0.287
Over all Acceptability	7.92^{a} ±0.313	8.08^{a} ±0.379	7.379	p>0.05	8.33^{a} ±0.256	8.08^{a} ±0.193	9.493	p>0.05	8.13^{a} ±0.231	7.58^{a} ±0.149	9.297	p>0.05

Table 4.17: Mean sensory scores of the products developed by using cowpea nuts

	Enrobed nuts					**Fried Nuts**				
	CoE	**EA**	**ECP**	**CV**	**CD**	**YFN**	**BFN**	**CPFN**	**CV**	**CD**
Colour	7.87±0.192	7.57±0.161	7.70±0.194	8.427	p>0.05	7.89^{a}±0.170	7.63ab±0.113	7.16b±0.257	10.806	0.538
Flavour	7.90±0.170	7.57±0.128	8.00±0.189	7.559	p>0.05	8.11a±0.105	7.68a±0.154	7.21b±0.271	8.977	0.453
Texture	8.27a±0.153	7.60b±0.163	7.97ab±0.186	7.455	0.443	7.89a±0.130	7.63ab±0.205	7.08b±0.302	12.753	0.632
Taste	8.27a±0.248	7.53b±0.172	7.93ab±0.128	8.026	0.475	8.00±0.202	7.74±0.168	7.34±0.311	12.445	p>0.05
Appearance	8.03±0.260	7.57±0.128	7.83±0.205	9.167	p>0.05	8.00a±0.153	7.89a±0.169	7.26b±0.214	8.627	0.438
Over all Acceptability	8.03±0.221	7.73±0.145	8.23±0.243	8.293	p>0.05	8.05a±0.179	7.84a±0.086	7.34b±0.180	8.968	0.458

± Standard deviation
Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$
CV- Coefficient of variation, CD-critical difference

Among all these five products four products i.e. *boondi*, *sev*, enrobed nuts and fried nuts were selected for further storage study. *Papad* had scored least in terms of appearance and hence it was dropped for further study.

4.8.1 Nutritional evaluation of cowpea products

4.8.1 Proximate composition: Proximate content is an important parameter to assess the basic nutritional quality of any food product. The data on proximate composition (dry weight basis) of four fried snacks based on cowpea are summarized under table 14.18. Ash content in foodstuff is assessed after destruction of organic matter present in it. Thus it may not necessarily be exactly equivalent to the mineral matter as some changes may occur due to volatilization or some interaction between constituents (Ranganna 1986). The ash content in the developed product was higher and approximately similar in enrobed nuts (4.94%) and *sev* (4.17%) followed by fried nuts (3.29 %) and *boondi* (2.52 %).

Table 4.18: Mean values of proximate composition of the cowpea snacks (gm/100gm)

	Moisture	**Ash**	**Fat**	**Fiber**	**Protein**	**CHO**	**Energy**
Sev	2.01±0.074	4.17±0.034	36.94±0.321	0.73±0.067	11.82±0.602	49.41±0.815	573.31±1.487
Boondi	5.89±0.319	2.52±0.070	34.97±0.922	0.55±0.018	12.72±0.358	55.50±0.927	582.59±4.599
Enrobed Nuts	1.26±0.191	4.94±0.051	42.42±0.207	2.95±0.118	18.43±0.355	32.54±0.583	585.66±0.415
Fried cowpea nuts	1.30±0.151	3.29±0.053	26.74±0.125	1.32±0.067	10.25±0.261	59.71±0.403	520.49±0.397

Note: dry weight basis

± Standard deviation

Fat provides energy and aids in transport of fat soluble vitamins, insulates and protects internal tissues and contributes to important cell processes (Jones *et al*. 1985 and Pamela *et al*. 2005). The analysed crude fat, with the true fat (triglycerides), other material soluble in ether such as phospholipids, sterols, essential oils and fat soluble pigments are also present in it (Ranganna 1986). Crude fat content was among the cowpea based snacks recorded lowest in fried cowpea nuts (26.74 %) and highest in enrobed nuts (42.42 %).

Crude fiber is the organic residue which remains after the food sample has been treated under standardized conditions with petroleum spirit, boiling dilute sulphuric acid, boiling dilute sodium hydroxide solution and alcohol. The crude fiber consists largely of cellulose together with a little lignin. The crude fiber content was noted higher i.e. 2.95 % in enrobed nuts followed by 1.32 in fried cowpea nuts, 0.73 % in *sev* and 0.55 % in *boondi.*

Protein content in the developed snacks was recorded maximum for enrobed nuts (18.43 %) followed by *boondi* (12.75%), *sev* (11.82 %) and fried nuts (10.25%). Enrobed fried nuts were prepared by enrobing cowpea flour added with spices on roasted peanuts, hence the protein content of enrobed fried nuts were higher.

4.8.2 Mineral content: The developed snacks were also analysed for calcium and iron content and presented under table 4.19. Highest calcium and iron content was noted in fried nuts i.e. 2.03 and 9.14 mg/100gm respectively. Marginal difference was noted in calcium and iron content was observed for *sev* and enrobed nuts. The present study reveals that all the developed snacks were rich source of iron content.

Table 4.19: Mean values of calcium and iron content in cowpea snacks (mg/100gm)

Cowpea products	Calcium	Iron
Sev	1.75 ± 0.056	7.43 ± 0.107
Boondi	1.38 ± 0.028	5.01 ± 0.087
Enrobed Nuts	1.71 ± 0.124	6.07 ±0.282
Fried Nuts	2.03 ± 0.071	9.14 ± 0.492

Note: dry weight basis

± Standard deviation

4.8.3 DPPH: The determination of the antioxidant activity of cowpea product extract was based on the DPPH radical scavenging activity through the IC_{50} parameter, which represents the concentration of the material necessary to inhibit 50 % of free radicals. Thus, a lower IC_{50} value shows a superior ability to neutralize free radicals and potential antioxidant content. The scavenging ability of methanol extract of the cowpea snacks are represented as IC_{50} of DPPH radical is shown in figure 4.6. Enrobed nuts followed by fried cowpea nuts had 208.17 mg/ml and 212.88mg/ml free radical scavenging activity respectively. The results of the present study revealed that the fried snacks also exhibit the antioxidant property.

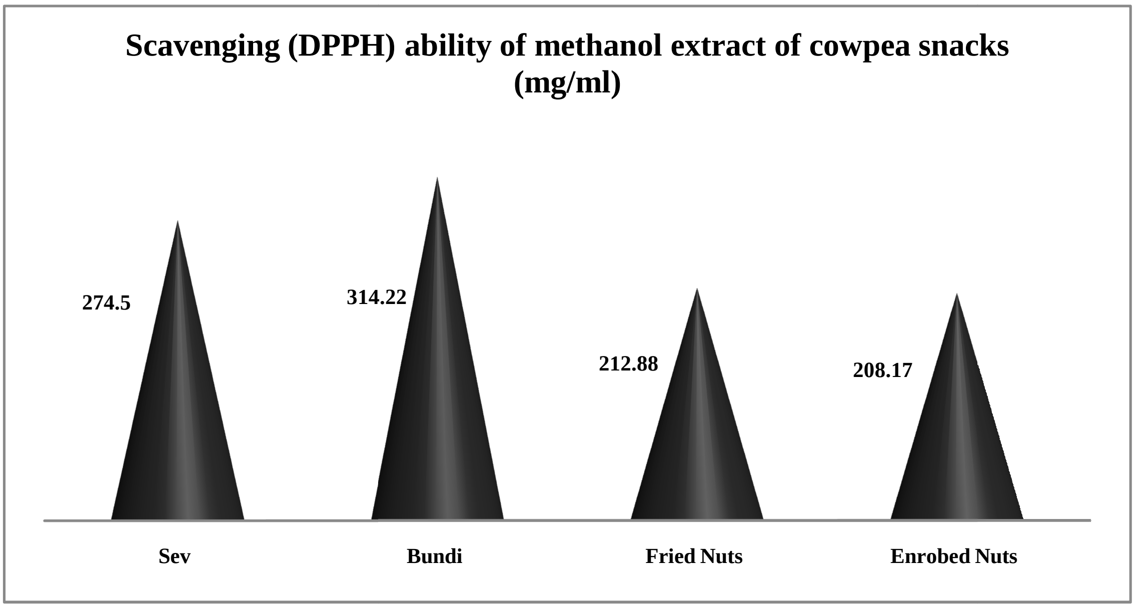


Figure 4.6: DPPH free radical scavenging activity of the developed cowpea snacks.

Kushwaha and co-workers in 2014 developed *khajure* and *mathri* snacks were supplemented with cowpea and wheat flour in different combinations. It was noted that *khajure* and *mathri* prepared by incorporation of cowpea flour were most acceptable up to levels of 40% and 20%, respectively. Further they computed the nutrient composition of cowpea incorporated products and concluded that cowpea supplemented food products may be utilized for solving the problem of protein energy malnutrition among young children in developing countries.

Various studies conducted on cowpea revealed that it an incredible source of many other health-promoting components, such as soluble and insoluble dietary fiber, phenolic compounds and minerals (Liyanage *et al*., 2014; Mudryj *et al*., 2012). These nutrients help in improving the quality of human health by offering a number of health benefits. Several studies revels that the consumption of cowpea exerts protective effects against the development of several chronic diseases. Snacks prepared by using cowpea as base ingredient could offer an overall improvement of nutritional status and there by healthy individual especially the young Indian population.

4.9 Shelf life evaluation of the cowpea products

4.9.1 Sensory evaluation of the cowpea products: Sensory evaluation of the products offers the opportunity to obtain a complete analysis the changes in the various properties of food as perceived by human senses during storage. Table 4.20 and 4.21 depicts the mean sensory scores of the stored products i.e. *boondi* (CPB); *sev* (CPS) and enrobed nuts (ECP); fried nuts (CPFN) respectively. CPB *boondi* was found to be acceptable as indicated by the score above 6 for all the attributes till 100 days of storage period. However significant decline was observed in all the attributes except colour of the *boondi* after 60 days of storage and slight rancid flavour was stated developing in the *boondi*.

In CPS *sev* significant change in flavour and taste was developed at 60th and 80th day of storage respectively. No significant difference was observed during 100 days of storage of enrobed nuts (ECP). However bitter taste was started developing at 80th day of storage and that effected the taste of the product. Non significant difference was observed in change in colour during storage period of 100 days in all the stored products. Change in flavour and taste was also non significant in enrobed nuts and fried nuts during storage period of 100 days.

Table 4.20 Mean sensory scores of *Boondi* during storage

	***Boondi* (CPB)**							
	0	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**
Colour	8.23^{a} ±0.166	8.23^{a} ±0.122	8.19^{a} ±0.133	8.15^{a} ±0.191	7.92^{a} ±0.137	7.88^{a}±0.228	7.748	$p>0.05$
Flavour	8.08^{a}±0.239	7.92^{a}±0.246	7.73^{a}±0.216	7.58^{a}±0.178	6.62^{b}±0.266	6.35^{b}±0.236	11.402	0.66
Texture	7.85^{a}±0.154	7.81^{a}±0.286	7.65^{a}±0.207	7.38^{a}±0.180	6.69^{b}±0.263	6.65^{b}±0.249	11.409	0.657
Taste	8.08^{a}±0.077	8.04^{a}±0.132	7.62^{a}±0.180	7.46^{a}±0.174	6.62^{b}±0.368	6.19^{b}±0.286	11.246	0.647
Appearance	7.96^{a}±0.038	7.92^{a}±0.178	7.88^{a}±0.162	7.85^{a}±0.119	7.77^{a}±0.122	7.62^{a}±0.180	5.821	$p>0.05$
Over all Acceptability	7.96^{a}±0.120	7.88^{a}±0.162	7.81^{a}±0.208	7.77^{a}±0.156	6.65^{b}±0.386	6.62^{b}±0.241	11.169	0.653

± Standard deviation

Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$

CV- Coefficient of variation, CD-critical difference

Table 4.21 Mean sensory scores of *Sev* during storage

	Sev (CPS)							
	0	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**
Colour	8.46^{a}±0.144	8.42^{a}±0.137	8.38^{a}±0.171	8.15^{a}±0.191	8.04^{a}±0.183	7.92^{a}±0.211	7.681	p>0.05
Flavour	8.77^{a}±0.122	8.77^{a}±0.092	8.73^{a}±0.108	8.42^{b}±0.125	8.35^{b}±0.067	7.92^{c}±0.077	3.852	0.257
Texture	8.65^{a}±0.131	8.62^{a}±0.129	8.54^{a}±0.120	8.42^{a}±0.125	8.35^{ab}±0.131	8.08^{b}±0.077	5.206	0.345
Taste	8.46^{a}±0.144	8.42^{a}±0.137	8.35^{a}±0.191	8.23^{ab}±0.122	7.96^{b}±0.120	7.88^{b}±0.140	5.664	0.365
Appearance	8.46^{a}±0.144	8.46^{a}±0.208	8.42^{a}±0.276	8.27^{a}±0.122	8.08^{a}±0.178	7.92^{a}±0.148	8.224	p>0.05
Over all Acceptability	8.69^{a}±0.175	8.62^{a}±0.129	8.62^{a}±0.129	8.35^{ab}±0.131	8.04^{bc}±0.089	7.92^{c}±0.077	5.39	0.354

± Standard deviation

Different alphabets in superscript in each row show significant difference between values at $p \leq 0.05$

CV- Coefficient of variation, CD-critical difference

4.9.2 Temperature and relative humidity: Temperature and relative humidity was also recorded and shown in figure 4.7. It was observed that at the 20th and 40th day of storage the humidity was higher. This also affected the moisture content of the products. After opening the packets the moisture was absorbed by the products. Due to this the crunchy texture of the products was lost and products became slightly soggy. The maximum effect was seen on the *boondi* (CPB) and *sev* (CPS).

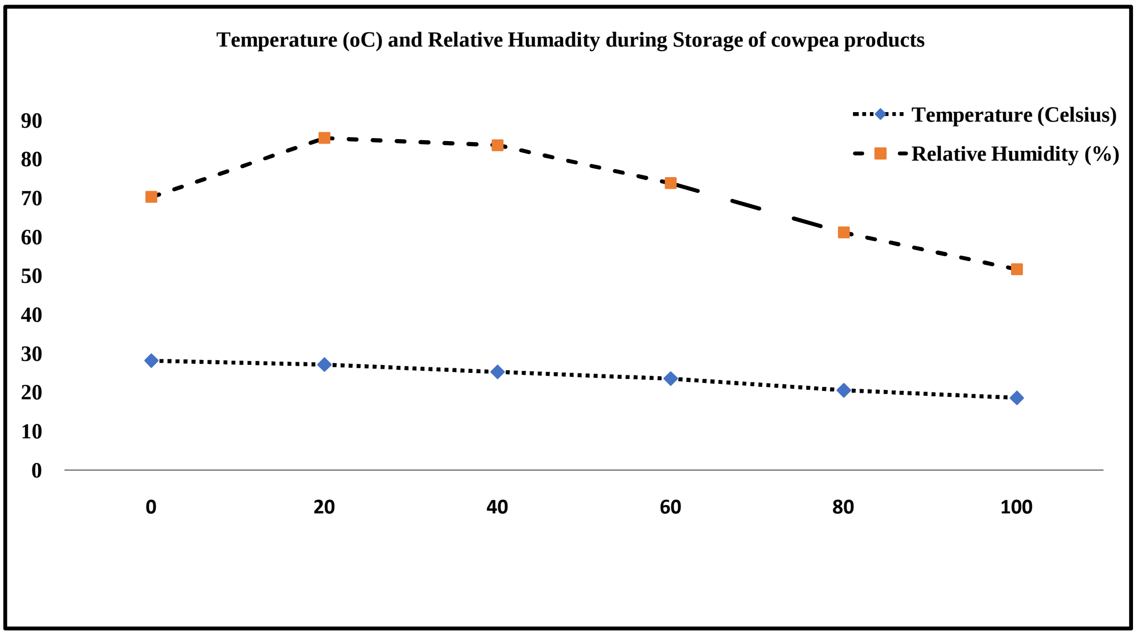


Figure 4.7: Temperature and relative humidity

4.9.3 Moisture content during storage period:

Moisture per cent was analysed at the interval of 20 days and presented in figure 4.8. Moisture content during storage of the fried snacks can lead to quality degradation and sensory attributes such as texture and finally result in shorter shelf life and rejection of the products (Tiwari, *et al.* 2011).

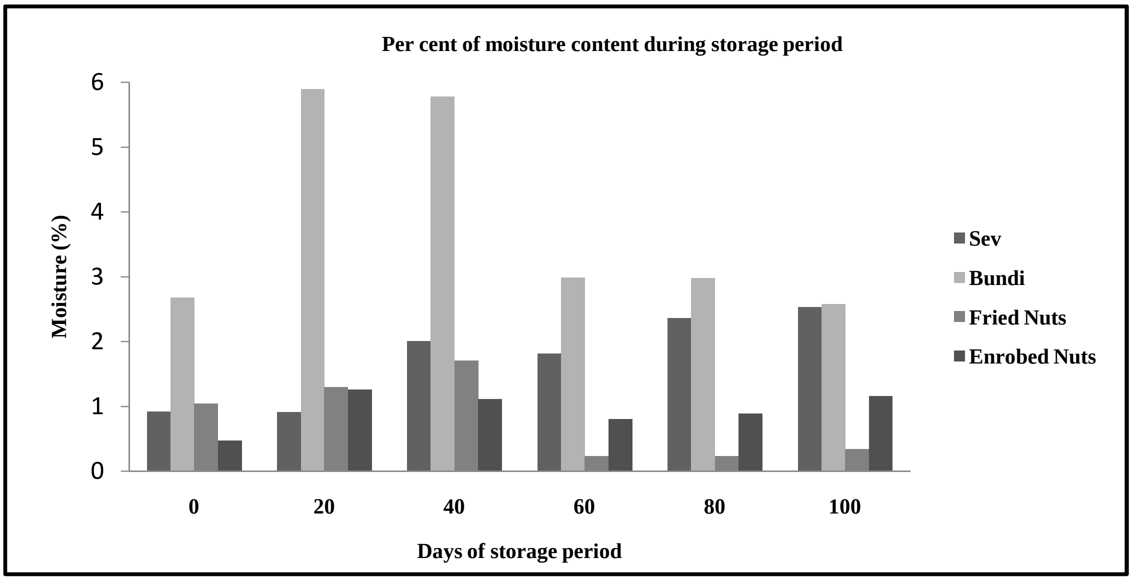


Figure 4.8: Per cent moisture content during storage period

4.9.4 Peroxide value: Figure 4.9 depicts the peroxide value after 100 days of storage. The maximum peroxide value was recorded in enrobed nuts (3.53 mEq/kg) followed by *boondi* (2.68 mEq/kg), Fried nuts (1.47 mEq/kg) and *Sev* (1.25 mEq/kg). Akinoso, *et al*, 2010 conducted a study on sesame (*Sesamum indicum* L) seeds processing for oil extraction and investigated effects of initial moisture content, roasting duration and temperature on initial peroxide value and oxidative stability. The study concluded that increase in roasting temperature and duration increased the oxidative stability and a reverse was observed with initial moisture content. High moisture content reduced the quality and storage life while heat treatment increased both the initial quality and storage life of the mechanically expressed oil. The enrobed nuts were formulated by coating peanuts which are known to be rich in fats. With this before enrobing heat was applied to roast it and then water was added for enrobing the batter followed by frying in last. Hence higher the amount of fat and added moisture content may be responsible for increased peroxide value during storage of the enrobed.

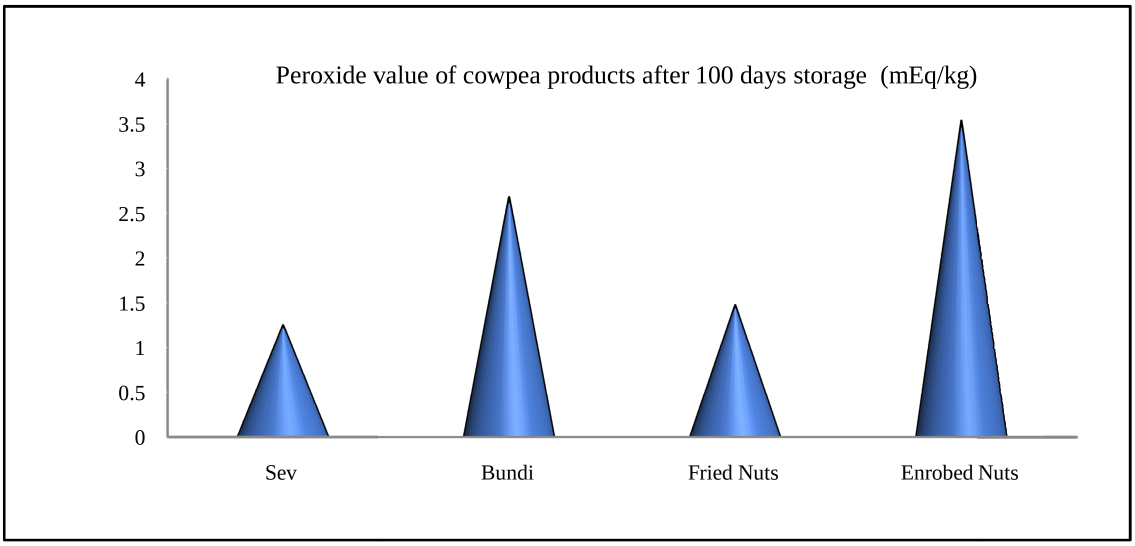


Figure 4.9: Peroxide value in products after 100 days of storage period.

When the *boondi* were placed in hot oil, the moisture content fell rapidly. The outer surface "crust" gets dried, providing a diffusion gradient, and the moisture inside the product is converted to steam, causing a pressure gradient. As this continues, the area surrounding the moisture escape site dries out and loses its hydrophilicity. Oil may then adhere to the product and enter into the product through the pores and also damaged areas (Ravi and Susheelamma, 2005). The acceptance of food product is based on the extent to which deterioration has occurred. Oxidative rancidity is a main reason of off flavour and degradation during storage of fried foods. This also leads to loss of nutritional quality and cause of concern for food safety. The oxidized fats in very high dosage have been shown to have toxic effects (Allen and Hamilton, 1983).

Part III

4.10 Training conducted for employment generation

Various on campus and off campus training were organized for the adoption of the technology (Table 4.22). The details of off campus training were also presented under Annexure V. The developed products were formulated and packed departmental laboratory and showcase at *kisan meal* for popularization and commercialization (Plate 4.1). Total 4 off campus trainings were organized and total 82 trannies were attended the training (Plate 4.2).

The trainings organized with the help of Directorate of Extension were not registered. These trainees were for far flung areas of Uttarakhand. Hence it was

Plate 4.1 Development, Packaging and showcasing the products at *kisan mela*

Ginger Sharbat
Ginger Candy
COW PEA FRIED NUTS
एवं स्वच्छता
अदरक शर्बत और कैंडी
खाद्य एवं पोषण विभाग

Plate 4.2 Different on campus and off campus trainings

कृषि विज्ञान केन्द्र काशीपुर
प्रशिक्षण कार्यक्रम

difficult to track and assist them. From the 4 off campus trainings, 3 trainings were on ginger processed products and one was on cowpea products. Some training programmes were suspended due to covid-19 pandemic.

Table 4.22: Different trainings organized for employment generation.

Technology	On campus/ off campus	Number of training	Total Number of trainees
Ginger	Off Campus	03	63
Ginger	On campus (Under Directorate of Extension)	03	56
Ginger	On campus	01	02
Cowpea	Off campus	01	19

4.11 Impact of the technology transferred and trainings imparted:

For processing of ginger candy did not required any machinery except stainless steel utensils and for ginger sherbet two things i.e. mixer grinder and cap crowing machine was required. All the kind of assistance was provided initially by the department of Foods and Nutrition and later by KVK Jeolikote.

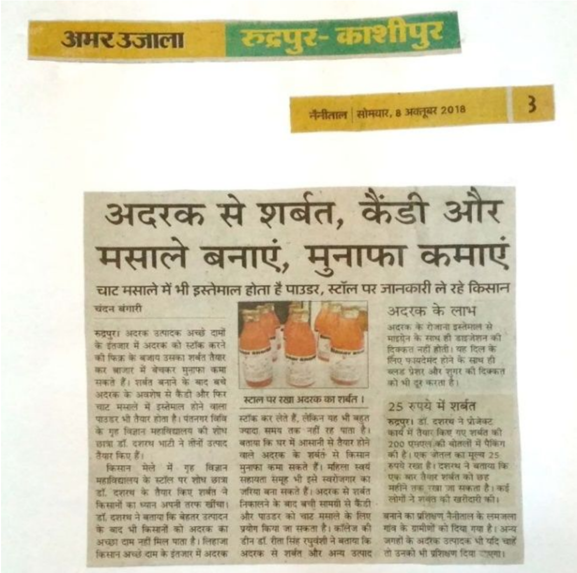
Among these total 84 trainees (off campus) 4 were adopted the technology and sold the ginger processed food products and one trainee was started processing cowpea fried nuts. The adoption rate was 11.11 percent for ginger products and 5.26 percent for cowpea products (Plate 4.3). Initially 6 kg ginger was processed per day for sherbet making. The profit could be increased by selling of dried ginger pulp also. This dried ginger pulp had a mild flavour hence it may be utilized as ingredient in bakery products, ice-creams and other product preparation. In case of candy, 5 kg ginger was processed per week. Candy required more time as compared to sherbet. Both the products were sold with the profit of more than 50 per cent. The profit margin may increase upto 100 per cent with increase in scale processing. This technology does not require specific equipment, hence very much suitable to the farmers. Nainital is one of the most popular tourist city as well as its climatic condition is cold. In this climatic condition people like to take ginger sherbet for both health and taste reason.

These products were also got place in newspaper as well and lots of youth and farmers contacted to get training (Plate 4.4) of these products. Mrs. Veenita Bora W/o Virendra Singh Bora received award from the Uttarakhand Governor, Mrs. Baby Rani Maurya, for making effort on employment generation (Plate 4.5). She is one of the adopters of ginger technology.

Plate 4.3 Technology Adopted by trannies and selling the products at different places

HILANS
राष्ट्रीय ग्रामीण आजीविका मिशन
बड़ी , सिल पिसी नूण ,खवैड़ , अचार, स्क्वैश , नमकीन , मसाले, लड्डू
चेतना स्वयं सहायता समूह
ग्राम व पोस्ट गेठिया (नैनीताल)

Plate 4.4 Newspaper cuttings published by different newspapers at different time


अमर उजाला रुद्रपुर- काशीपुर

नैनीताल | सोमवार, 8 अक्तूबर 2018 3

अदरक से शर्बत, कैंडी और मसाले बनाएं, मुनाफा कमाएं

चाट मसाले में भी इस्तेमाल होता है पाउडर, स्टॉल पर जानकारी ले रहे किसान

चंदन बंगारी

रुद्रपुर। अदरक उत्पादक अच्छे दामों के इंतजार में अदरक को स्टॉक करने की फिक्र के बजाय उसका शर्बत तैयार कर बाजार में बेचकर मुनाफा कमा सकते हैं। शर्बत बनाने के बाद बचे अदरक के अवशेष से कैंडी और फिर चाट मसाले में इस्तेमाल होने वाला पाउडर भी तैयार होता है। पंतनगर विवि के गृह विज्ञान महाविद्यालय की शोध छात्रा डॉ. दशरथ भाटी ने तीनों उत्पाद तैयार किए हैं।

किसान मेले में गृह विज्ञान महाविद्यालय के स्टॉल पर शोध छात्रा डॉ. दशरथ के तैयार किए शर्बत ने किसानों का ध्यान अपनी तरफ खींचा। डॉ. दशरथ ने बताया कि बेहतर उत्पादन के बाद भी किसानों को अदरक का अच्छा दाम नहीं मिल पाता है। लिहाजा किसान अच्छे दाम के इंतजार में अदरक स्टॉक कर लेते हैं, लेकिन यह भी बहुत ज्यादा समय तक नहीं रह पाता है। बताया कि घर में आसानी से तैयार होने वाले अदरक के शर्बत से किसान मुनाफा कमा सकते हैं। महिला स्वयं सहायता समूह भी इसे स्वरोजगार का जरिया बना सकते हैं। अदरक से शर्बत निकालने के बाद बची सामग्री से कैंडी और पाउडर को चाट मसाले के लिए प्रयोग किया जा सकता है। कॉलेज की डीन डॉ. रीता सिंह रघुवंशी ने बताया कि अदरक से शर्बत और अन्य उत्पाद बनाने का प्रशिक्षण नैनीताल के लमजला गांव के ग्रामीणों को दिया गया है। अन्य जगहों के अदरक उत्पादक भी यदि चाहें तो उनको भी प्रशिक्षण दिया जाएगा।

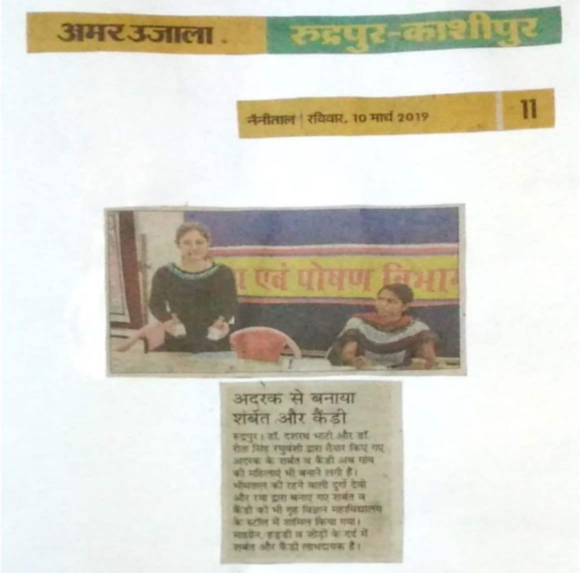
स्टाल पर रखा अदरक का शर्बत।

अदरक के लाभ

अदरक के रोजाना इस्तेमाल से माइग्रेन के साथ ही डाइजेशन की दिक्कत नहीं होती। यह दिल के लिए फायदेमंद होने के साथ ही ब्लड प्रेशर और शुगर की दिक्कत को भी दूर करता है।

25 रुपये में शर्बत

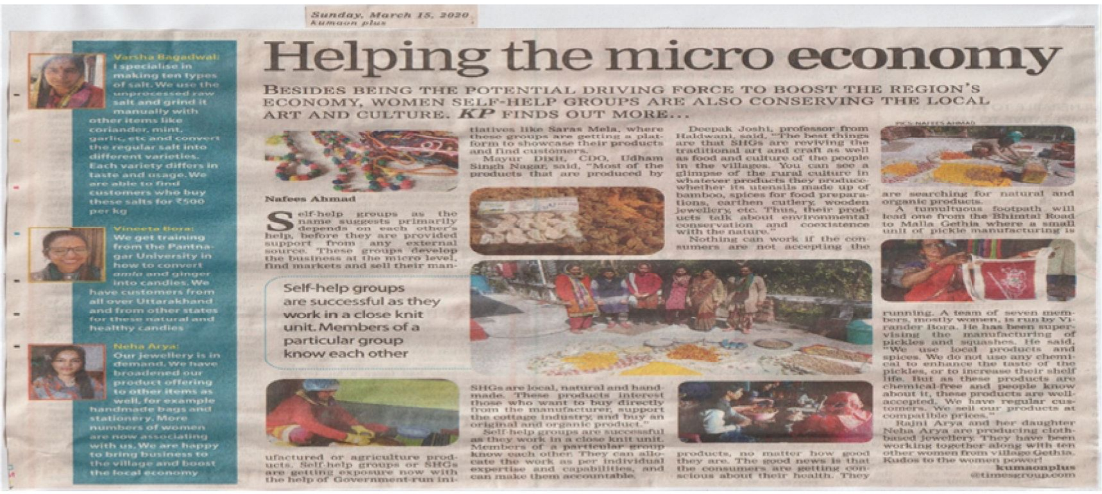
रुद्रपुर। डॉ. दशरथ ने प्रोजेक्ट कार्य में तैयार किए गए शर्बत को 200 एमएल की बोतलों में पैकिंग की है। एक बोतल का मूल्य 25 रुपये रखा है। दशरथ ने बताया कि एक बार तैयार शर्बत को छह महीने तक रखा जा सकता है। कई लोगों ने शर्बत की खरीदारी की।


अमर उजाला रुद्रपुर-काशीपुर

नैनीताल | रविवार, 10 मार्च 2019 11

अदरक से बनाया शर्बत और कैंडी

रुद्रपुर। डॉ. दशरथ भाटी और डॉ. रीता सिंह रघुवंशी द्वारा तैयार किए गए अदरक के शर्बत व कैंडी अब गांव की महिलाएं भी बनाने लगी हैं। भीमताल की रहने वाली दुर्गा देवी और रमा द्वारा बनाए गए शर्बत व कैंडी को भी गृह विज्ञान महाविद्यालय के स्टॉल में शामिल किया गया। माइग्रेन, हड्डी व जोड़ों के दर्द में शर्बत और कैंडी लाभदायक है।


Sunday, March 15, 2020
kumaon plus

Helping the micro economy

BESIDES BEING THE POTENTIAL DRIVING FORCE TO BOOST THE REGION'S ECONOMY, WOMEN SELF-HELP GROUPS ARE ALSO CONSERVING THE LOCAL ART AND CULTURE. *KP* FINDS OUT MORE...

Varsha Bagadwal: I specialise in making ten types of salt. We use the unprocessed raw salt and grind it manually with other items like coriander, mint, garlic, etc and convert the regular salt into different varieties. Each variety differs in taste and usage. We are able to find customers who buy these salts for ₹500 per kg

Vineeta Bora: We get training from the Pantnagar University in how to convert *amla* and ginger into candies. We have customers from all over Uttarakhand and from other states for these natural and healthy candies

Neha Arya: Our jewellery is in demand. We have broadened our product offering to other items as well, for example handmade bags and stationery. More numbers of women are now associating with us. We are happy to bring business to the village and boost the local economy

Nafees Ahmad

Self-help groups as the name suggests primarily depends on each other's help, before they are provided support from any external source. These groups develop the business at the micro level, find markets and sell their manufactured or agriculture products. Self-help groups or SHGs are getting exposure now with the help of Government-run initiatives like Saras Mela, where these groups are getting a platform to showcase their products and find customers.

Mayur Dixit, CDO, Udham Singh Nagar, said, "Most of the products that are produced by SHGs are local, natural and handmade. These products interest those who want to buy directly from the manufacturer, support the cottage industry, and buy an original and organic product."

Self-help groups are successful as they work in a close knit unit. Members of a particular group know each other. They can allocate the work as per individual expertise and capabilities, and can make them accountable.

Deepak Joshi, professor from Haldwani, said, "The best things are that SHGs are reviving the traditional art and craft as well as food and culture of the people in the villages. You can see a glimpse of the rural culture in whatever products they produce whether its utensils made up of bamboo, spices for food preparations, earthen cutlery, wooden jewellery, etc. Thus, their products talk about environmental conservation and coexistence with the nature."

Nothing can work if the consumers are not accepting the products, no matter how good they are. The good news is that the consumers are getting conscious about their health. They are searching for natural and organic products.

A tumultuous footpath will lead one from the Bhimtal Road to Malla Gethia where a small unit of pickle manufacturing is running. A team of seven members, mostly women, is run by Virander Bora. He has been supervising the manufacturing of pickles and squashes. He said, "We use local products and spices. We do not use any chemical to enhance the taste of the pickles, or to increase their shelf life. But as these products are chemical-free and people know about it, these products are well-accepted. We have regular customers. We sell our products at compatible prices."

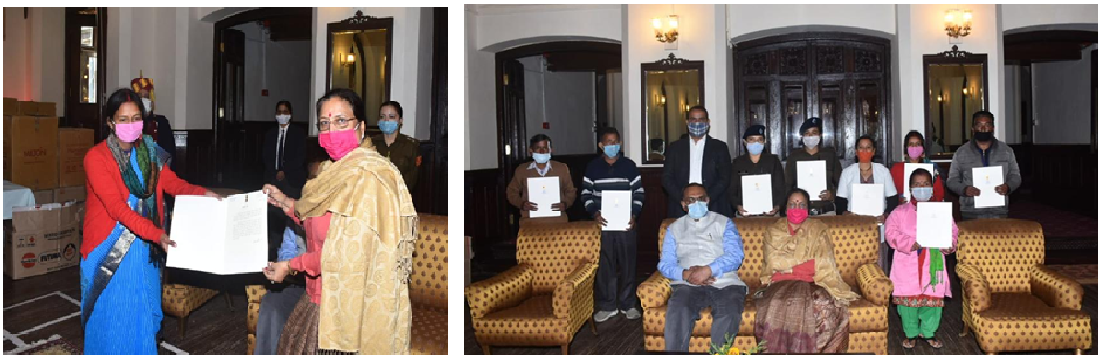
Rajni Arya and her daughter Neha Arya are producing cloth-based jewellery. They have been working together along with ten other women from village Gethia. Kudos to the women power!

kumaonplus@timesgroup.com

Self-help groups are successful as they work in a close knit unit. Members of a particular group know each other

PICS: NAFEES AHMAD

Plate 4.5: Mrs. Veentia Bora received award form Governor Smt. Baby Rani Maurya



4.12 Development of module for establishing food-based agribusiness

On the basis of quarries of the trainees while conducting training were recorded in point. The problems faced by the trainees during starting of the own business were also noted. With these records the agribusiness module small scale enterprises was developed and presented under the table 14.23. In table 14.24 the module content are presented.

Table 4.23: Agribusiness Module for small scale entrepreneurs: Ginger products and by products for 5 Days

1	**Title of the Module**	Agribusiness Module for small scale entrepreneur: ginger products and by products
2	**Sector**	Food processing and preservation
3	**Entry Qualification**	10th standard
4	**Minimum Age**	18 Years
5	**Terminal Competency**	After completion of the trannie will be able to start own entrepreneur. Able to sale the developed product in market
6	**Duration (in Hrs)**	5 days (25 contact hours)

Table 4.24: Content of the module

S. No.	**Theory**	**Practical**	**Contact Hours**		
			T	D	P
1	Importance of primary, secondary, and tertiary processing. Concept of value addition, conversion of raw materials to consumer foods, Knowledge of importance of ginger products & their market value;	Juice preparation and Candy making	1	1	3
2	Quality assurance of raw material, standards & grades ginger and their products, key parameters which influence final product quality; Machineries for primary foods; Food processing machineries; Raw materials selection, Effect of addition of ingredients on final products	Practice to make ginger candy and Juice; Observation in change in raw material during processing;	1	1	3

S. No.	**Theory**	**Practical**	**Contact Hours**		
			T	D	P
3	Study the different Brands available in market (National and International) Study consumer, market and challengers. Survey on commercially available ginger products; Identification of the space in processing chain where the ginger processed product can be made	By product utilization its economic value and care. Product formulation by using by products	1	1	3
4	Study of the various equipment which can be utilized to check the final product quality. Maintain the record of these parameters. Cost calculation of the final product, break even point. Different techniques to sale the product in market.	Work on Development of canvas business model. Juice preparation.	1	1	3
5	Practicing hygiene and safety aspects in food preparation; Regulation by FSSAI; Registration of the business. Common website which can be checked to get the information about regulation. Government programmes and policies for MSMES and Start ups	Practice on these websites to get updated information. Registration on.	1	1	3
			5	**5**	**15**

The elaborated module was also published in the form of book so that it may be distributed in KVK's. This module will provide all kind of help in staring of entrepreneur on ginger as well as provide help in best utilization of the by products.

CHAPTER V

SUMMARY AND CONCLUSION

Agribusiness skills related to food processing can play key role for addressing the issue and food and nutrition security. With this, empowerment of rural women and small farmers for value added products can help in achieving livelihood support. Agribusiness is effective tool to overcome the problem of unemployment, food and nutrition security and giving employment generation opportunities. Processing of locally cultivated foods by very small farmers could help them to increase the economic value of the crop.

Various processing technologies have been developed by research students of the universities. Through technology transfer of these less processed food items to the small farmers, youth and women could help in increase in gainful employment and reduce the migration. Most of the small farmers sell their produce without processing and in return gets low prices. Processing or value addition could increase the cost of raw produce by many folds. Hence the present study was carried out on agribusiness module of value-added underutilized food products towards livelihood support of hills population. Two food items i.e. ginger and cowpea were selected for product formulation and trainings were given for employment generation. Therefor, the present study was divided in three parts i.e. Part I: Development of ginger products, nutritional and storage studies of the selected developed ginger products. Part II: Development of cowpea products, nutritional and storage of the selected cowpea products. Part III: Training of these processed ginger products and impact was recorded in terms of adoption of these techniques for employment generation.

Part I: Experiment was conducted to develop value added ginger products from tender ginger rhizomes keeping in view its therapeutic properties and to avoid postharvest loss. Ginger candy, ginger sherbet and ginger toffee was developed from the tender ginger rhizomes. Ginger toffee was developed to utilize the ginger pulp residue obtained while processing of the ginger sherbet. All the products were found acceptable at sensory parameters. All the products were liked by the panel members. From the developed products ginger candy and ginger sherbet with 2% citric acid were found to be acceptable and stored for 6 months for further study. Nutrient composition of tender ginger, mature ginger, ginger candy, ginger sherbet, ginger precipitate obtained while processing of ginger sherbet. Mature ginger was higher in ash (7.48 %), fat (4.48%), crude fiber (9.75%) and protein (10.54%) content on dry weight bases. However tender ginger had similar content of ash and fat i.e. 3.80%. Carbohydrate content was noted maximum in tender ginger. Among the processed products ginger candy noted 1.68 % of crude fiber. Ginger sherbet was prepared by dilution and hence its significant impact on the nutrient composition was observed. Ginger precipitate was collected while the processing of ginger for juice and noted that it had 7.04 % protein and 3.80% of ash content.

Need assessment for ginger processing skills was done through extensive survey conducted in Bhimtal block, Nainital District, Uttarakhand. Total 50 farmers were selected and interviewed through structured questionnaire for data collection. The study revealed that 75.0 per cent of the farmers were growing ginger and 67.57 per cent of farmers using 2 to 25 kg as ginger seeds. During peak season, the selling price of ginger ranged between Rs. 30/kg to 80/kg. However, the price of ginger varies widely with production. Eighty four per cent of the farmers were ready to prepare these products, however 64 per cent wanted to sell ginger *sherbet* in market.

Survey was conducted on small vendors for the commercialization and perception prospects about the developed ginger product. The survey study was carried out at Udham Singh Nagar, Uttarakhand. Selection of respondent was done on the basis of the willingness of vendors to be part of the study. Total 38 small vendors were surveyed and it was observed that organoleptically both the products were acceptable. As per the results of organoleptical assessment it was found that 76.38 per cent of respondents liked ginger sherbet where as ginger candy was liked by 81.69 per cent of respondents. It was also observed that 81. 58 per cent 84.21 per cent were agree to keep the ginger sherbet and ginger candy with other products for sell.

Part II: The organoleptic properties of traditional Indian snacks formulated were assessed by using cowpea. Five products were formulated by using cowpea *viz boondi, sev, papad,* enrobed nuts and fried nuts. Bengal gram flour was used as control for comparing *boondi, sev* and *papad* with the cowpea products. However fried nuts prepared from cowpea was compared with black and yellow fried soybean. The sensory evaluation employed 15 trained panellists to assess colour, flavour, texture, taste, appearance and overall acceptability of all the products at nine-point hedonic rating scale. The *sev, boondi, papad* and enrobed nuts developed by using 100% cowpea flour were comparable with Bengal gram flour products and acceptable at 9-point hedonic rating scale. Similarly, fried nut was also at par with soybean fried nuts. Among all these products four products i.e. *boondi, sev*, enrobed nuts and fried nuts were selected for nutritional storage study. *Boondi* was found to be acceptable till 60 days of storage period. Non-significant difference was observed in change for fried nut during storage period of 100 days in all the stored products. Change in flavour and taste was also non-significant in enrobed nuts and fried nuts during storage period of 100 days. These products were evaluated for proximate composition, mineral content i.e. iron, calcium and free radical scavenging activity. Nutritional quality evaluation was done at Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology. Cowpea snacks were high in protein, fibre and mineral ash and ranging from 10.25 - 18.43%, 0.55 -2.95 % and 2.52- 4.94 % respectively. Calcium and iron content was ranged between 1.30 to 2.03 mg/100gm and 5.01 to 9.14 mg/ 100 gm respectively. Present study reveals that cowpea snacks could be considered the best in terms of nutritional quality, especially for young children.

Part III: Trainings were conducted to ensure livelihood security for the local youth and small farmers. On campus and off campus trainings were conducted for the adoption of the technology and adoption rate was also calculated. Four off campus and four on campus training were organized and total 82 were beneficiaries. From the 4 off campus trainings, 3 trainings were on ginger processed products and one was on cowpea products.

CHAPTER VI

PROJECT OUTPUT OUTCOMES AND IMPACT

Every deed has its impact on the society. This part of the report allows to see beyond the direct results of the research project. For achieving the main objectives of the research projects, resources are utilized to obtain tangible outputs and purpose of the project is the outcomes that are expected after all the efforts. Hence the present project was also assessed for output, outcomes, impacts and presented as follows:

Output of the project

- Total two ginger products namely ginger candy and ginger sherbet and four cowpea products namely cowpea *sev, boondi,* fried nuts and enrobed nuts were standardized.
- The products developed have got six months of shelf life which is suitable duration for commercialization.
- One module entitled "Agribusiness Module for small scale entrepreneur: ginger products and by products" was developed for the upcoming entrepreneurs.
- Villagers 140 in number, comprising male, female and youth got trained in product formulated. Through 8 on campus and off-campus trainings.
- Three trainees adopted ginger technology for making and 01 trainee adopted cowpea technology for commercialization.
- The linkages were developed between the new entrepreneurs KVK's for future assistance.
- For academic interest the research findings are published in the form of one popular article, 03 abstract in seminar/ conferences, research papers 6 + 1 (published and under processing) and one module for upcoming entrepreneurs were published.

Outcomes of the project

Being a small project, the four entrepreneurs developed and they increased their family income by selling value added products of agricultural produce of their family.

This will serve as example for other families of the village to get into production of value-added produce and increase their family income. Due to processing of ginger, a semi perishable item loss due to spoilage, dehydration, germination will also be reduced. As the processing involves some working hands therefore it will be source of income generation for unemployment youth of the village itself. By use this technology of processing will improve use of ginger and cowpea products thereby bringing diversity in routine intake of the families. In COVID-19 time when ginger is propagated by Ayush Mantralaya these small enterprises will catch up as immunity buster. Thereby improving income generation and health of the people.

The module developed on the agribusiness shall be instrumental to take up agribusiness for several interested youth.

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Annexure I

Score card for organoleptic evaluation of developed food product

Name: ____________________ Product Name:

_____________________Date:_____________

Score the following products for different parameters given

Acceptability	Maximum score	A	B	C
Colour	10			
Flavour	10			
Texture	10			
Taste	10			
Appearance	10			
Overall acceptability	10			

Scoring scale

1-2 : Very poor
3-4 : Poor
5-6 : Fair
7-8 : Good
9-10 : Very good

Hedonic Scale	A	B	C
Like extremely			
Like very much			
Like moderately			
Like slightly			
Neither like nor dislike			
Dislike slightly			
Dislike moderately			
Dislike very much			
Dislike extremely			

Comments:

Signature

Annexure II

Proforma of ginger processed product need assessment among farmers

प्रोफार्मा

प्रत्यार्थी का नाम.. आयु तथा लिंग...

पता: वर्तमान व्येवसाय

पिन कोड मांक

फोन नम्बर: शैक्षणिक योग्यता

1. **क्या आप अदरक का उत्पाद करते हैं ?**
2. **यदि हॉं तो कितना उत्पाद होता हैं ?**
3. **उगाए गये अदरक का प्रयोग काहां करते हैं ?**

स्वयम् / परिवार के लिए	**मात्रा**
बीज के लिए	**मात्रा**
बेचने के लिए	**मात्रा**
अन्य प्रयोग	**मात्रा**

4. **आप अदरक का प्रयोग किस प्रकार करते हैं ? कम (6) से अधिक (1) के क्रम में लगाऐं।**

चाय में **सब्जी में** **अचार के रूप में**

सुखा कर सैंठ के रूप में **शर्बत के रूप में** **कैंण्डी**

5. **आपको शर्बत कैसा लगा। (√ चिन्न अंकित करें)**

अत्यधिक अच्छा **बहुत अच्छा** **अच्छा**

थोड़ा अच्छा **ठीक ठीक** **थोड़ा खराब**

खराब **बहुत खराब** **अत्यधिक खराब**

6. क्या आप अदरक के मुल्य सम्वर्धन को बनाने प्रशिक्षण लेना चाहेगें ? हाँ /नही

7. यदि नही तो क्यों ?____

8. क्या आप शर्बत को स्वयं बना कर बेचने का व्यवसाय करना चाहेगें। हाँ /नही

9. यदि नही तो क्यों? ____

10. क्या बाजार में कोई अन्य प्रतिस्पर्द्धात्मक उत्पाद है? यदि हाँ तो कृपया कर उन उत्पादो का नाम लिखें।

11. अदरक के अलावा किसी अन्य कृषि उत्पाद के मुल्य सम्वर्धन का प्रशिक्षण लेना चाहेगें हाँ /नही

12. यदि हाँ तो उन कृषि उत्पादो का नाम बताएं।

13. कोई अन्य टिप्पणि

Annexure III

Perception of vendors about the processed ginger products survey proforma

Proforma (प्रोफार्मा)

Name of Respondent /प्रत्यार्थी का नाम ____

Name of Shop (If any)/ दुकान का नाम ____

Contact No. /फोन नम्बर: ____

Address/ पता: ____

---

1. How much you liked the product (1.Poor to 10 Liked very much):________________

   आपको उत्पाद कैसा लगा (1 बहुत बुरा 10 बहुत अच्छा)।

2. Whether you would like to sell the prepared product: Yes / No

   क्या आप बने हुए उत्पाद को बेचना चाहेगें। हाँ /नही

3. If no then why? ____

   यदि नही तो क्यों ?____

4. Whether you would like to prepare & sell the product Yes / No

   क्या आप इस उत्पाद को स्वयं बना कर बेचना चाहेगें। हाँ /नही

5. If no then why? ____

   यदि नही तो क्यों? ____

6. According to you what should be the cost of the product:__________________

   आपके अनुसार इस उत्पाद की क्या कीमत होनी चाहिए।

7. Are any competitive products available in market? If yes then provide name of those products.

   क्या बाजार में कोई अन्य प्रतिस्पर्द्यात्मक उत्पाद है? यदि हाँ तो पया कर उन उत्पादो का नाम लिखें।

8. Do you know that any agency for regulation of all the food products sold in market regulates the quality of the food products? Yes / No / Don't know

क्या आप जानते हैं कि खाद्य उत्पादो की गुणवत्ता को परखने के लिऐ कौई सस्था कार्य करती हैं ?
हाँ /नहीं / पता नहीं

Any other comment/ कोई अन्य टिप्पणि

Annexure IV

गृह विज्ञान महाविद्यालय,
गोविन्द बल्लभ पन्त कृषि एवं प्रौद्योगिकी विश्वविद्यालय,
पन्तनगर–263145, ऊधम सिंह नगर, उत्तराखण्ड

कृषि उत्पादों के मूल्यसम्वर्धन हेतु प्रशिक्षण

पंजीकरण फार्म

बड़े अक्षरों में भरें

2 पासपोर्ट आकार के फोटो दें। (चिपकाएं नहीं)

1	आवेदनकर्ता का नाम	
2	पिता/पति का नाम	
3	स्थाई पता	पिन कोड क्रमांक
4	सम्पर्क विवरण	दूरभाष
5	मोबाइल	
6	आधार नम्बर	
7	ई–मेल	
8	जन्मतिथि	
9	शैक्षणिक योग्यता	
10	वर्तमान गतिविधि	
11	प्रशिक्षण का महीना	मई 2018
12	प्रशिक्षण का विषय	कृषि उत्पादों के मूल्यसम्वर्धन हेतु प्रशिक्षण [illegible] शर्बत)

दिनांकः   हस्ताक्षर

स्थान   नाम

Annexure V

Address List of **1st** “Training on Ginger Sharbat and Candy”

During May 23, 2018

Mrs. Lata W/o Shree Mahesh Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9917518940 Aadhar No:	**Mrs. Ramo Devi W/o Devi Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 527600309427
Mrs. Sunita Devi W/o Munna Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9690202013 Aadhar No: 547482364351	**Ms. Lalita D/o Balwant Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 867723653305
Mrs. Gyanwati W/o Baldev Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No:	**Mrs. Rameshwari W/o Krushpal Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 846653430202
Mrs. Suvita Devi W/o Virander Singh Rana, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9756821780 Aadhar No: 510699795062	**Mrs. Chandra Prabha W/o Survendra,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No:
Mrs. Choti Devi W/o Lal Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No:	**Mrs. Jeenat Devi W/o Vinod Rana,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9927547485

Mrs. Dayawati W/o Gauri Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9917596124 Aadhar No: 410814016402	**Mrs. Kiranwati W/o Mahendra Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Naga Ph No. Aadhar No: 918542575153
Mrs. Urvesh W/o Vikram Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9639290072 Aadhar No: 325755751354 (Husband's)	**Mrs. Praveshwati W/o Kuwar Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 503752489090
Mrs. Rajnandini W/o Anil Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9568643167 Aadhar No:	**Mrs. Phoolwati W/o Rameshwer,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No:
Mrs. Vandna W/o Gopal Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 8057505140 Aadhar No: 844940674815	**Mrs. Neemwati W/o Chander Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 602146973577
Mrs. Manglesh W/o Prehlad Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9639668388 Aadhar No:727616666371	**Mrs. Shakuntla Devi W/o Preem Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 997821892138
Mrs. Sarvesh Devi W/o Chanden Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9837770375 Aadhar No: 400045491009	**Mrs. Chamo Devi W/o Dulat Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. Aadhar No: 824117789281

Mrs. Amrawati W/o Mohan Singh, Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9058493832 Aadhar No: 640129031946	**Mrs. Laxmi Devi W/o Kalash Singh,** Village Audali, PO- Lama Kheda, Tehsil Sitarganj, Dist. Udham Singh Nagar Ph No. 9917569768 Aadhar No: 821435383572

Address List of **2nd** “Training on Ginger Sharbat and Candy”

During December 27, 2018

Mrs. Kavita Jantwal W/o Shree Preetem Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9758745350 Aadhar No: 689787578566	**Mis. Divya D/o Lat. Rajender Singh Jantwal,** H. No.- 106, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 7055284313 Aadhar No: 367543108659
Mrs. Mamta W/o Ranjeet Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand	**Mrs. Neha W/o Narendra Singh Jantwal** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand
Mrs. Rama Devi W/o Kundan Singh Jantwal Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9917224127 Aadhar No: 736382404721	**Mrs. Durga Devi W/o Lat. Rajender Singh Jantwal,** H. No.- 106, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No.9837668944 Aadhar No: 429347551071
Mrs. Bhawna Devi W/o Shree Puran Singh, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 8449199880 Aadhar No: 375626516784	**Mrs. Sony D/o Tara Singh Jantwal,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9758996584 Aadhar No: 698696913658

Mrs. Janki Devi W/o Shree Narender Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 6397407706	**Mrs. Khimuli Devi W/o Lat. Shree Bacchi Singh,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9758996584
Mrs. Rashmi Jantwal W/o Shree Sanjay Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9917363301 Aadhar No:705740259438	**Mrs. Heera Jantwal W/o Shree Peetam Singh Jantwal,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9917736756 Aadhar No: 934084774396
Mrs. Alka W/o Shree Deewan Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9917187319	**Mrs. Kunti Devi W/o Shree Bhuwan Singh Jantwal,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9756664226
Mrs. Ruchi Jantwal D/o Mr. Balam Singh, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 912598390	**Mrs. Asha Choudhary W/o Pushpendar Choudhary,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 8859583481
Mrs. Indra Devi W/o Kamal Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9536461723	**Mrs. Bhagwati Devi W/o Shree Balam Singh Jantwal,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9719471055
Miss. Hema Jantwal D/o Shree Kundan Singh Jantwal, Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 8859636011 Aadhar No: 298041680535	**Mrs. Janki Devi W/o Shree Narayan Singh Jantwal,** Jantwal Gavn Lamajala, Dograa, Nainital- 263126, Uttarakand Ph No. 9756664226 Aadhar No: 603993336529

Address List of 3rd "Training on Ginger Sharbat and Candy"

During June 05, 2019

Mrs. Shalini W/o Mr. Govind, Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410336540	**Mrs. Ganga Kotilya W/o Mr. Krishan Kotilya,** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9761109066 (Son's No.)
Mrs. Hema Bhatt W/o Gireesh Chander Bhatt Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 8650534305	**Mrs. Nandini Agerwal W/o Vijender Agerwal** Village Gathiya, Block Bheemtal, PO Sanitoriyam, Dist. Nanital- 263127 Ph No. 9719375264
Mrs. Madhu W/o Naveen Chander Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9756560129	**Mrs. Rekha Devi W/o Gajender Kumar** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410375989
Mrs. Kamla Devi W/o Shyam Lala Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9627304723	**Mrs. Rekha Devi W/o Baalkishan** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 75139487
Mrs. Pushpa Devi W/o Preem Rana Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127	**Mrs. Khatti Devi W/o Jagdeesh Prasad** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127
Mrs. Prema Devi W/o Late. Rajendra Prasad Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9917996933	**Mrs. Kajal W/o Itti Kumar** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9917996933

Mrs. Manju Devi W/o Mahendra Singh Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410312758	**Mrs. Maya Kotilya W/o Ganesh Singh Kotilya** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 7351336355
Mrs. Veenita Bora W/o Virendra Singh Bora Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410144266, 9410176482 Aadhar No: 515499101153 E- mail: borav5972@gmail.com	**Mrs. Uma Devi W/o Raam Kishor** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9719762276
Mrs. Meena W/o Gajender Singh Village Gathiya, Block Bheemtal, PO Sanitoriyam Dist. Nanital 263127 Ph No. 9410375989	**Mrs. Parvati Koranga W/o Hayat Singh Koranga** Village Gathiya, Block Bheemtal, PO Sanitoriyam Dist. Nanital 263127 Ph No. 9458962949

Address List of 4th “Training on Cowpea”

During June 30, 2019

Mrs. Hema Bhatt W/o Gireesh Chander Bhatt Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 8650534305	**Mrs. Nandini Agerwal W/o Vijender Agerwal** Village Gathiya, Block Bheemtal, PO Sanitoriyam, Dist. Nanital- 263127 Ph No. 9719375264
Mrs. Madhu W/o Naveen Chander Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9756560129	**Mrs. Rekha Devi W/o Gajender Kumar** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410375989

Mrs. Kamla Devi W/o Shyam Lala Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9627304723	**Mrs. Rekha Devi W/o Baalkishan** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 75139487
Mrs. Pushpa Devi W/o Preem Rana Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127	**Mrs. Khatti Devi W/o Jagdeesh Prasad** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127
Mrs. Prema Devi W/o Late. Rajendra Prasad Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9917996933	**Mrs. Kajal W/o Itti Kumar** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9917996933
Mrs. Manju Devi W/o Mahendra Singh Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410312758	**Mrs. Maya Kotilya W/o Ganesh Singh Kotilya** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 7351336355
Mrs. Veenita Bora W/o Virendra Singh Bora Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410144266, 9410176482 Aadhar No: 515499101153 E- mail: borav5972@gmail.com	**Mrs. Uma Devi W/o Raam Kishor** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9719762276
Mrs. Meena W/o Gajender Singh Village Gathiya, Block Bheemtal, PO Sanitoriyam Dist. Nanital 263127 Ph No. 9410375989	**Mrs. Parvati Koranga W/o Hayat Singh Koranga** Village Gathiya, Block Bheemtal, PO Sanitoriyam Dist. Nanital 263127 Ph No. 9458962949
Mrs. Shalini W/o Mr. Govind, Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9410336540	**Mrs. Ganga Kotilya W/o Mr. Krishan Kotilya,** Village Gathiya, Block Bheemtal, PO Santoriyan, Dist. Nanital- 263127 Ph No. 9761109066 (Son's No.)

Annexure VI

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Organoleptic properties and shelf life evaluation of snacks formulated by using cowpea

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Abstract

The present study investigated the organoleptic properties of traditional Indian snacks formulated by using cowpea and shelf life of these developed products for six months. Five products were formulated by using cowpea *viz boondi, sev, papad,* enrobed nuts and fried nuts. Bengal gram flour was used as control for comparing *boondi, sev* and *papad* with the cowpea products. However fried nuts prepared from cowpea was compared with black and yellow fried soybean. The sensory evaluation employed 15 trained panellists to assess colour, flavour, texture, taste, appearance and overall acceptability of all the products at nine point Hedonic rating scale. The *sev, boondi, papad* and enrobed nuts developed by using 100% cowpea flour were comparable with Bengal gram flour products and acceptable at 9 point hedonic rating scale. Similarly fried nut was also at par with soybean fried nuts. Among all these products four products i.e. *boondi, sev*, enrobed nuts and fried nuts were selected for further storage study. *Boondi* was found to be acceptable till 60 days of storage period. Non significant difference was observed in change for fried nut during storage period of 100 days in all the stored products. Change in flavour and taste was also non significant in enrobed nuts and fried nuts during storage period of 100 days.

Keywords: Cowpea, sensory quality, traditional Indian snacks, keeping quality and fried foods

Introduction

In present era snack foods have become a vital part of diets due to convenience offered by these food items. The term snack or snack food is difficult to define. The dictionary meaning of the snack is 'tit-bid', which is a meal in the broadest sense (Tettweiler, 1991) [21]. Thus snacks are a food, which offer a light, meals. They are convenience to eat, involving no preparation time or efforts by consumer. The demand of snack foods is increasing day by day. Consequently, many types of snack foods are introduced into market place by manufacturer.

Pulses are important group of crops that provide high quality protein complementing cereal proteins pre-dominantly for vegetarian population of country like India. Cowpea, (*Vigna unguiculata* (L.) Walp) is one of the pulse crops which have been grown in India, since ancient times. It is a native of Africa, belongs to the family *leguminosae* (Goncalves *et al*., 2016; Lazaridi *et al*., 2016; Karapanos *et al*., 2017) [9, 12, 10]. This is the most versatile pulse crop because of its drought tolerance, suitability for multiple cropping systems and multiple uses such as green vegetable and food legumes. Besides all this cowpea is considered as an incredible source of many other health-promoting components, such as soluble and insoluble dietary fiber, phenolic compounds, minerals, and many other functional compounds, including B group vitamins (Liyanage *et al*., 2014; Mudryj *et al*., 2012) [13, 15]. Thus, cowpea contributes greatly toward improving the quality of human health by offering a number of health benefits especially for developing countries like India. Pantnagar University has developed many early maturing grain cowpea varieties under pulse improvement programme aiming to increase per capita availability of legumes in the state. Grain cowpea varieties are high yielding, early maturing, well grown and fit in rice wheat cropping system in context of Uttarakhand, India wherein the lands are marginal with low productivity and rain fed agriculture (Pandey and Singh 2006) [16].

In India most of the pulses are consumed as *dal* or as boiled salted preparation. Keeping the health benefits of cowpea in view there is great need to increase it's utilization as snack foods. This act will also help to release pressure on single crop.

Improved production of cowpea is undoubtedly necessary to meet pulse demand but it is equally important to enhance diversified utilization of uncommon pulse like cowpea as snack food in Indian market.Keeping all this in view the present study deals with the formulation and sensory evaluation of cowpea snacks, and six months shelf life of these developed products.

Methodology

Procurement of raw material: Cowpea variety Pant Lobia-1 was procured from Vegetable Science Research Center, GB Pant University of agriculture and Technology, Pantnagar, Uttarakhand. The variety was selected on basis of recommendation of scientist from Vegetable Science Research Center. Other raw material such as black soybean, yellow soybean, Bengal gram flour, peanuts, refined oil, spices etc. were purchased from the local market of Pantnagar. All the raw materials were procured in a single lot.

Primary processing: Cowpea, black and yellow soybean seeds and peanut seeds were cleaned thoroughly and made free from dust, dirt, spoilt grains, stone and other foreign matter. Cowpea seeds were divided into two parts and one part was ground into flour of mesh size of 70 and other part was kept as whole to prepare fried nuts.

Product development: On the basis of common and popular snacks in market as well as known to the general Indian population total five products were selected. These cowpea products were *boondi, sev, papad*, enrobed nuts and fried nuts. All these products were developed at the Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand.

a. **Preparation of *Boondi*:** This is a popular deep fat fried Indian traditional snack food prepared from the Bengal gram flour batter with suitable consistency and is fried in small bolls through perforated ladle (Thangum 1965) [22]. For the present study 50 gm cowpea flour and 75 ml water was mixed to form batter (CPB). After keeping aside for 30 minutes and it was poured through perforated ladle over hot oil to make small balls/ drops. Control was prepared by replacing cowpea flour from Bengal gram flour (CoB).

b. **Preparation of *sev*:** It is small noodle shaped fried and crunchy snack popular in India made from Bengal gram flour dough containing pepper, chilli powder, turmeric and is relished for its texture and aroma. The thickness of these noodles varies. The hand operated stainless steel *sev* machine has six different disc templates. Control (CoS) was prepared by using Bengal gram flour- 50 gm, oil- 5ml, salt, spices, asafoetida powder, chilli powder and turmeric and water 20 ml. The dough was passed through the disc and deep fried. Cowpea *sev* (CPS) was prepared by replacing Bengal gram flour from cowpea flour.

c. **Preparation of *papad*:** *Papad* is a thin, circular shaped, fried wafer like product and normally made from pulse kernel flour with spices and other additives (Saxena *et al.* 1989) [20]**.** Control was prepared by using Bengal gram flour (CoP), oil, black pepper, salt, asafoetida powder, *ajowan* seeds, chilli powder and turmeric powder. Test sample was prepared by using cowpea flour (CPP).

d. **Preparation of enrobed nuts:** Roasted peanut were coated with Bengal gram flour containing salt, asafoetida powder and chat masala powder. Three types of enrobed nuts were prepared. Control (CoE) was prepared by using Bengal gram flour 15gm, 1 gm arrowroot powder, salt, asafoetida powder, chat masala and 50 gm roasted peanuts. All these were mixed, 10ml water was added, mixed and fried. Two test enrobed nuts was prepare, one test sample was prepared by replacing Bengal gram flour (EA) and second one was prepared replacing arrowroot powder and Bengal gram flour completely (ECP).

e. **Preparation of fried nuts:** Control was prepared by using whole yellow soybean. The cowpea resembles with yellow soybean in appearance. The fried nuts were compared with both yellow (YFN) and black soybean (BFN). Soybean was soaked for 4 hours in lukewarm water and blanched for 20 minutes. Water was removed seeds were spread on blotting paper for 1 hour to remove extra water. After this seeds were fried, salt and chat masal was added to it. Cowpea fried nuts (CPFN) was prepared by soaking in lukewarm water for 1 hour and then blanched for 10 minutes then spread on blotting paper for 1 hour to remove extra water. After this seeds were fried and in last salt and chat masala was added.

Oil was changed after once used for frying of the developed products.

Sensory evaluation of the developed products: The organoleptic evaluation of the developed products was done at nine point Hedonic rating scale (from dislike extremely to like extremely). Coded samples were subjected to sensory evaluation after 12 hours of the production. Overall 13 semi trained panellist were evaluated the developed products. Scores were awarded for colour, texture, flavour, taste and overall acceptability.

On the bases of sensory evaluation four products were selected to study the storage of the developed products.

Storage of the developed products: On the basis of sensory evaluation four most acceptable products were stored for 100 days. All the selected products were packaged in flat pouch bag aluminium foil film liner moisture proof zipper sealed bags (130 mm x 205 mm). The packets were of 75 gm in weight and kept in a plastic container at ambient condition. At every 20th day a fresh packet was opened for sensory and quality evaluation. During storage temperature and relative humidity on the day when the packets were opened for sensory evaluation was also recorded. Moisture content was evaluated at the interval of 20 days by using the standard method suggested by AOAC, (1999) [3]. Peroxide value was evaluated after the completion of the 100 days by the standard method of AOAC, (1999) [3].

Statistical analysis: One way analysis of variance (ANOVA) was applied to determine significant differences between means, with the significance level taken at ($P< 0.05$). Statistical analysis of data was performed using WASP (Web Agri Stat Package) software version 2.0.

Results and Discussion

Sensory evaluation of the developed products: The mean sensory scores of the developed products are presented under table 1. The CPB *boondi* was at par at 0.05% level of significance with CoB *boondi* in all the sensory attributes. Texture of CPB *boondi* was more crisp then the CoB *boondi*. Cowpea *sev* (CPS) was comparable with CoS in all the sensory quality and was significantly better in texture. However, CoS *sev* had significantly high scores in terms of colour and appearance at 0.05% level of significance. Colour of the product also affects the appearance

papad prepared by cowpea (CPP) was acceptable however CoP *papad* was liked very much by the panel members. The texture of CoP *papad* liked by the panel members and significantly higher then CPP at 0.05 percent level of significance. The colour of CPP *papad* was also light brown and that affected the appearance of the products.

These all lead to decreased overall acceptability of CPP. However both the variations of *papad* were liked by the panel members.

Enrobed nut prepared by using 100% cowpea (ECP) was at par with Bengal gram flour enrobed nuts. The enrobed nuts prepared from cowpea and arrowroot powder (EA) was hard texture then ECP and CoE enrobed nuts. Overall acceptability of ECP had higher scores by the panel members due to its crunchy texture. Soybean fried nuts (YNF) and black soybean nuts (BFN) were varied significantly in terms of colour and appearance. The cowpea nuts (LFN) was at par with YNF fried nuts in terms of all the sensory parameters. All the three products were acceptable at nine point hedonic rating scale.

Bhagirathi *et al*., 1992 [7] had developed *papad* by using two cowpea verities and black gram and reported that the cowpea *papad* were placed in liked very much and liked extremely categories. The quality of various products made from cowpea flour in different parts of world which are dependent on the functionality of cowpea flour; as influenced by processing technique, cowpea variety, particle size distribution of the flour, ingredients and the hydration pattern of the flour mixture.(Appiah *et al*., 2011; Apea–Bah *et al*., 2016) [5, 4].

Several other studies on thereputic aspect of cowpea revels that the consumption of cowpea exerts protective effects against the development of several chronic diseases, such as gastrointestinal disorders (Trehan *et al*., 2015) [24], diabetes (Rotimi *et al*, 2013; Barnes *et al*., 2015) [19, 6] and several types of cancer (Chon, 2013; Khalid and Elharadallou, 2013) [8, 11]. With this, cowpea is also helpful in weight reduction (Perera *et al*., 2016) [17], improve digestion and strengthen blood circulation (Trehan *et al*., 2015) [24].

Among all these five products four products i.e. *boondi*, *sev*, enrobed nuts and fried nuts were selected for further storage study. *Papad* had scored least in terms of appearance and hence it was dropped for further study.

Sensory quality of the selected products during storage

Sensory evaluation of the products offers the opportunity to obtain a complete analysis the changes in the various properties of food as perceived by human senses during storage. Table 2 (a) and (b) depicts the mean sensory scores of the stored products i.e. *boondi* (CPB); *sev* (CPS) and enrobed nuts (ECP); fried nuts (CPFN) respectively.

CPB *boondi* was found to be acceptable as indicated by the score above 6 for all the attributes till 100 days of storage period. However significant decline was observed in all the attributes except colour of the *boondi* after 60 days of storage and slight rancid flavour was stated developing in the *boondi*.

In CPS *sev* significant change in flavour and taste was developed at 60th and 80th day of storage respectively. No significant difference was observed during 100 days of storage of enrobed nuts (ECP).

However bitter taste was started developing at 80th day of storage and that effected the taste of the product. Non significant difference was observed in change in colour during storage period of 100 days in all the stored products. Change in flavour and taste was also non significant in enrobed nuts and fried nuts during storage period of 100 days.

Temperature and relative humidity: Temperature and relative humidity was also recorded and shown in figure1 (a). It was observed that at the 20th and 40th day of storage the humidity was higher. This also affected the moisture content of the products. After opening the packets the moisture was absorbed by the products. Due to this the crunchy texture of the products was lost and products became slightly soggy. The maximum effect was seen on the *boondi* (CPB) and *sev* (CPS).

Moisture content during storage period:

Moisture per cent was analysed at the interval of 20 days and presented in figure 1 (b). Moisture content during storage of the fried snacks can lead to quality degradation and sensory attributes such as texture and finally result in shorter shelf life and rejection of the products (Tiwari, *et al*. 2011) [23].

Peroxide value

Figure (c) depicts the peroxide value after 100 days of storage. The maximum peroxide value was recorded in enrobed nuts (3.53 mEq/kg) followed by *boondi* (2.68 mEq/kg), Fried nuts (1.47 mEq/kg) and *Sev* (1.25 mEq/kg). Akinoso, *et al*, 2010 [1`] conducted a study on sesame (*Sesamum indicum* L) seeds processing for oil extraction and investigated effects of initial moisture content, roasting duration and temperature on initial peroxide value and oxidative stability. The study concluded that increase in roasting temperature and duration increased the oxidative stability and a reverse was observed with initial moisture content. High moisture content reduced the quality and storage life while heat treatment increased both the initial quality and storage life of the mechanically expressed oil. The enrobed nuts were formulated by coating peanuts which are known to be rich in fats. With this before enrobing heat was applied to roast it and then water was added for enrobing the batter followed by frying in last. Hence higher the amount of fat and added moisture content may be responsible for increased peroxide value during storage of the enrobed. When the *boondi* were placed in hot oil, the moisture content fell rapidly. The outer surface "crust" gets dried, providing a diffusion gradient, and the moisture inside the product is converted to steam, causing a pressure gradient. As this continues, the area surrounding the moisture escape site dries out and loses its hydrophilicity. Oil may then adhere to the product and enter into the product through the pores and also damaged areas (Ravi and Susheelamma, 2005) [18]. The acceptance of food product is based on the extent to which deterioration has occurred. Oxidative rancidity is a main reason of off flavour and degradation during storage of fried foods. This also leads to loss of nutritional quality and cause of concern for food safety. The oxidized fats in very high dosage have been shown to have toxic effects (Allen & Hamilton, 1983) [2].

Table 1: Mean sensory scores of the products developed by using cowpea

	Boondi				***Sev***				***Papad***				**Enrobed nuts**					**Fried Nuts**				
	CoB	**CPB**	**CV**	**CD**	**CoS**	**CPS**	**CV**	**CD**	**CoP**	**CPP**	**CV**	**CD**	**CoE**	**EA**	**ECP**	**CV**	**CD**	**YFN**	**BFN**	**CPFN**	**CV**	**CD**
Colour	8.23^{a} ± 0.246	7.83^{a} ± 0.386	7.837	p>0.05	8.58^{c} ± 0.229	7.58^{b}±0.229	7.460	0.765	8.25^{a}±0.218	7.58^{b}±0.149	7.928	0.564	7.87±0.192	7.57±0.161	7.70±0.194	8.427	p>0.05	7.89^{a}±0.170	7.63ab±0.113	7.16b±0.257	10.806	0.538
Flavour	8.00^{a} ± 0.246	7.92^{a} ±0.336	9.628	p>0.05	7.92^{a} ±0.288	7.50^{a} ±0.151	9.138	p>0.05	7.92^{a} ±0.229	7.46^{a} ±0.311	11.677	p>0.05	7.90±0.170	7.57±0.128	8.00±0.189	7.559	p>0.05	8.11a±0.105	7.68a±0.154	7.21b±0.271	8.977	0.453
Texture	7.75^{a} ±0.305	8.17^{a} ±0.366	5.940	p>0.05	7.75^{a} ±0.351	8.08^{a} ±0.229	9.585	p>0.05	8.17^{a}±0.112	7.42^{b}±0.149	5.641	0.395	8.27a±0.153	7.60b±0.163	7.97ab±0.186	7.455	0.443	7.89a±0.130	7.63ab±0.205	7.08b±0.302	12.753	0.632
Taste	7.88^{a} ±0.315	7.92^{a} ±0.379	7.260	p>0.05	8.08^{a} ±0.229	7.92^{a} ±0.193	8.286	p>0.05	8.17^{a} ±0.207	7.58^{a} ±0.229	8.945	p>0.05	8.27a±0.248	7.53b±0.172	7.93ab±0.128	8.026	0.475	8.00±0.202	7.74±0.168	7.34±0.311	12.445	p>0.05
Appearance	7.83^{a} ±0.322	7.67^{a} ±0.376	7.612	p>0.05	8.25^{a}±0.179	7.63^{b}±0.186	6.881	0.491	8.08^{a}±0.149	6.83^{b}±0.112	4.288	0.287	8.03±0.260	7.57±0.128	7.83±0.205	9.167	p>0.05	8.00a±0.153	7.89a±0.169	7.26b±0.214	8.627	0.438
Over all Acceptability	7.92^{a} ±0.313	8.08^{a} ±0.379	7.379	p>0.05	8.33^{a} ±0.256	8.08^{a} ±0.193	9.493	p>0.05	8.13^{a} ±0.231	7.58^{a} ±0.149	9.297	p>0.05	8.03±0.221	7.73±0.145	8.23±0.243	8.293	p>0.05	8.05a±0.179	7.84a±0.086	7.34b±0.180	8.968	0.458

Table 2(a): Mean sensory scores of *Boondi* and *Sev* during storage

	***Boondi* (CPB)**								***Sev* (CPS)**							
	0	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**	**0**	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**
Colour	8.23^{a} ±0.166	8.23^{a} ±0.122	8.19^{a} ±0.133	8.15^{a} ±0.191	7.92^{a} ±0.137	7.88^{a}±0.228	7.748	p>0.05	8.46^{a}±0.144	8.42^{a}±0.137	8.38^{a}±0.171	8.15^{a}±0.191	8.04^{a}±0.183	7.92^{a}±0.211	7.681	p>0.05
Flavour	8.08^{a}±0.239	7.92^{a}±0.246	7.73^{a}±0.216	7.58^{a}±0.178	6.62^{b}±0.266	6.35^{b}±0.236	11.402	0.660	8.77^{a}±0.122	8.77^{a}±0.092	8.73^{a}±0.108	8.42^{b}±0.125	8.35^{b}±0.067	7.92^{c}±0.077	3.852	0.257
Texture	7.85^{a}±0.154	7.81^{a}±0.286	7.65^{a}±0.207	7.38^{a}±0.180	6.69^{b}±0.263	6.65^{b}±0.249	11.409	0.657	8.65^{a}±0.131	8.62^{a}±0.129	8.54^{a}±0.120	8.42^{a}±0.125	8.35^{ab}±0.131	8.08^{b}±0.077	5.206	0.345
Taste	8.08^{a}±0.077	8.04^{a}±0.132	7.62^{a}±0.180	7.46^{a}±0.174	6.62^{b}±0.368	6.19^{b}±0.286	11.246	0.647	8.46^{a}±0.144	8.42^{a}±0.137	8.35^{a}±0.191	8.23^{ab}±0.122	7.96^{b}±0.120	7.88^{b}±0.140	5.664	0.365
Appearance	7.96^{a}±0.038	7.92^{a}±0.178	7.88^{a}±0.162	7.85^{a}±0.119	7.77^{a}±0.122	7.62^{a}±0.180	5.821	p>0.05	8.46^{a}±0.144	8.46^{a}±0.208	8.42^{a}±0.276	8.27^{a}±0.122	8.08^{a}±0.178	7.92^{a}±0.148	8.224	p>0.05
Over all Acceptability	7.96^{a}±0.120	7.88^{a}±0.162	7.81^{a}±0.208	7.77^{a}±0.156	6.65^{b}±0.386	6.62^{b}±0.241	11.169	0.653	8.69^{a}±0.175	8.62^{a}±0.129	8.62^{a}±0.129	8.35^{ab}±0.131	8.04^{bc}±0.089	7.92^{c}±0.077	5.390	0.354

Boondi: Control *boondi* (CoB), Cowpea *boondi* (CPB); *Sev***:** Control *sev* (CoS), Cowpea *sev* (CPS); *Papad*: Control *papad* (CoP), Cowpea *papad* (CPP); Enrobed nuts**:** Control (CoE), Cowpea and arrowroot powder enrobed nuts (EA), Cowpea flour enrobed nuts (ECP); Fried nuts**:** Whole yellow soybean (YFN), black soybean (BFN) and Cowpea fried nuts (CPFN)

± Standard deviation Different alphabets in superscript in each row show significant difference between values CV- Coefficient of variation, CD-critical difference

Table 2(b): Mean sensory scores of enrobed nuts and fried nuts during storage

	Enrobed (ECP)								**Fried Nuts (CPFN)**							
	0	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**	**0**	**20**	**40**	**60**	**80**	**100**	**CV**	**CD**
Colour	8.54^{a}±0.144	8.46^{a}±0.183	8.46^{a}±0.144	8.38^{a}±0.171	8.27^{a}±0.216	8.12^{a}±0.278	8.343	p>0.05	8.38^{a}±0.140	8.31^{a}±0.175	8.23^{a}±0.263	8.23^{a}±0.201	8.15^{a}±0.154	8.19^{a}±0.192	8.690	p>0.05
Flavour	8.46^{a}±0.144	8.42^{a}±0.183	8.35^{a}±0.249	8.38^{a}±0.241	7.96^{ab}±0.120	7.69^{b}±0.208	8.641	0.557	8.46^{a}±0.243	8.42^{a}±0.178	8.42^{a}±0.225	8.37^{a}±0.175	8.19^{a}±0.106	8.15^{a}±0.296	9.238	p>0.05
Texture	8.62^{a}±0.140	8.54^{a}±0.183	8.54^{a}±0.144	8.23^{a}±0.224	8.12^{a}±0.213	8.04^{a}±0.230	7.551	p>0.05	8.54^{a}±0.144	8.58^{a}±0.137	8.42^{a}±0.195	8.38^{a}±0.129	8.27^{a}±0.184	8.23^{a}±0.122	6.672	p>0.05
Taste	8.62^{a}±0.129	8.65^{ab}±0.131	8.62^{ab}±0.140	8.46^{ab}±0.183	8.15^{bc}±0.154	7.81^{c}±0.223	7.124	0.469	8.69^{a}±0.133	8.62^{a}±0.140	8.54^{a}±0.144	8.54^{a}±0.144	8.50^{a}±0.160	8.46^{a}±0.215	6.762	p>0.05
Appearance	8.46^{a}±0.144	8.42^{a}±0.159	8.35^{a}±0.222	8.23^{a}±0.166	8.12^{a}±0.213	8.08^{a}±0.265	8.382	p>0.05	8.62^{a}±0.140	8.58^{a}±0.137	8.54^{a}±0.144	8.42^{a}±0.137	8.38^{a}±0.140	8.42^{a}±0.137	5.626	p>0.05
Over all Acceptability	8.58^{a}±0.137	8.50^{a}±0.160	8.46^{a}±0.215	8.35^{a}±0.131	8.19^{a}±0.223	8.08^{a}±0.178	7.554	p>0.05	8.62^{a}±0.140	8.58^{a}±0.137	8.54^{a}±0.215	8.52^{a}±0.212	8.50^{a}±0.139	8.46^{a}±0.144	7.299	p>0.05

± Standard deviation Different alphabets in superscript in each row show significant difference between values

CV- Coefficient of variation, CD-critical difference

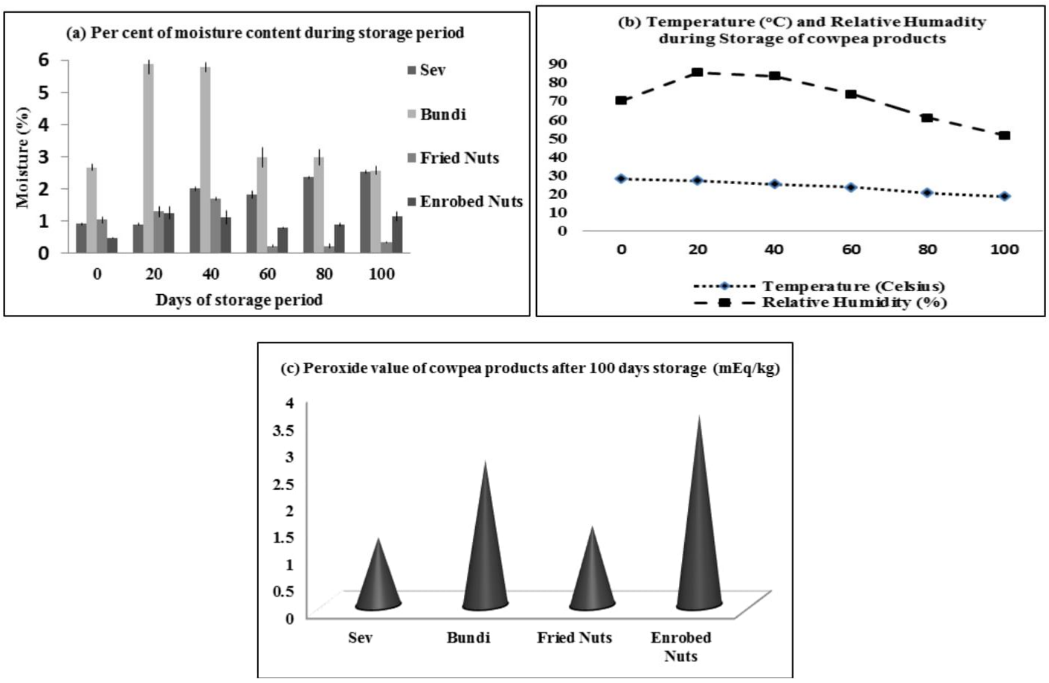

Fig 1: (a) Temperature and relative humidity (b) Per cent moisture content during storage period and (c) Peroxide value in products after 100 days of storage period.

Conclusion

Cowpea flour and seed both can be utilized as snacks and may be helpful to cater the need of snack market in India. Besides this *boondi* prepared by cowpea may also be utilized as sweet *laddu* formation. Other sweet products such as *laddu*, *barfi* etc. which are prepared traditionally by using Bengal gram flour needed to be explored by using cowpea flour. Cowpea could be best alternative of Bengal gram flour and the snacks prepared by using it.

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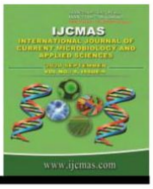

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Nutritional Quality Evaluation of Popular Indian Fried Snacks Based on Cowpea

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ABSTRACT

Keywords

Cowpea, Indian snacks, Black-eyed beans, Chemical parameter, Ready to eat (RTE)

Article Info

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Fried snacks are popular among young Indian population. An experiment was conducted for nutritional quality evaluation of the fried cowpea snacks. *Boondi, sev,* enrobed nuts and fried nuts were formulated by using cowpea. These products were evaluated for proximate composition, mineral content i.e. iron, calcium and free radical scavenging activity. Nutritional quality evaluation was done at Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology. Cowpea snacks were high in protein, fibre and mineral ash and ranging from 10.25 - 18.43%, 0.55 -2.95 % and 2.52-4.94 % respectively. Calcium and iron content was ranged between 1.30 to 2.03 mg/100gm and 5.01 to 9.14 mg/ 100 gm respectively. Present study reveals that cowpea snacks could be considered the best in terms of nutritional quality, especially for young children.

Introduction

Snacks are small, light, very handy, and simple meals which do not replace main meals. These snacks add to the total food and nutrient intake of individuals. In India people love to eat snacks and considered to be a habit. These snacks are usually chips, *namkeens*, lightly processed or fried and ready-to-eat food products. This made the processed food industry more dynamic and productive. Resulting all above, gobs of conventional foods especially fried snacks are available in Indian market.

Recent years, Indian snack market has undergone various changes due to high competition among multi-national companies which lead to high standards for the regional and small food processers. Local and regional food processors also play an important role through developing distinctive products and flavours by using local and indigenous food produce. With all these contributory factors Indians also have an emotional connection with eating snacks and this continues to drive the market towards growth. The increasing per capita income of the people, modern lifestyle, urbanisation and increase in the number of working mothers etc. give wings to the snacks industry (Noor *et al.,* 2012). Revenue in the Snack Food segment amounts to US$5,839m in 2020. The market is expected to grow annually by 6.3% CAGR 2020-2023 (https://www.statista.com/outlook/40110000/119/snack-food/ind ia). The total salty snacks market in India is estimated at Rs 29,000 crore, with an annual growth of 24%. The health snacks sub-segment is estimated to be around 2% of the overall snacks market (https://economictimes.indiatimes.com/industry/cons-products/fmcg/itc-jumps-on-healthy-snacks-ban dwagon/articleshow/70301268.cms ?from=mdr).

Cowpea (*Vigna unguiculata*) is one of the versatile pulse crops due to its wide uses and applications as food for humans; however it is not very much popular in India. It is an important grain legume in developing countries like India. To mitigate the problem of chronic energy deficiency, protein energy malnutrition and for increasing per capita availability of pulses, researchers are focusing on production and evaluation of physical characteristics and nutritional composition of uncommon pulses like cowpea.

Improved varieties of pulse crops has high production, mature early, grow well and fit for inter cropping especially for rice and wheat in context of Uttarakhand, wherein the lands are marginal with low productivity and rain fed agriculture (Pandey and Singh, 2006). Pantnagar University has developed many early maturing grain cowpea varieties under pulse improvement programme. As per recommendation of scientist working under this programme, cowpea snacks were developed by using cowpea variety PL-1. This paper deals with the nutritional composition of the developed cowpea snacks.

Materials and Methods

Different permutation and combinations were employed for formulation of popular Indian fried snacks by using cowpea (Pant Lobia- 1) as base ingredient. After standardization and sensory evaluation flour products i.e. *sev, boondi,* enrobed nuts (peanuts were enrobed by using cowpea flour with added spices) and fried cowpea nuts were finalized for nutritional quality evaluation. The following parameters were evaluated:

Proximate composition

All the developed cowpea products were analysed for the proximate composition- i.e. moisture, protein (N x 6.25), crude fat (ether extraction), ash and crude fibre (AOAC, 1995). The carbohydrate, content was calculated by difference, i.e. 100, the sum of the per cent of ash, protein, fat and fibre (AOAC, 1995). Energy value was calculated by multiplying the physiological values obtained for carbohydrate, protein and fat, with 4, 4 and 9 respectively and adding up the values (AOAC, 1995).

Mineral content

All the four developed cowpea products were analysed for calcium and iron content through Atomic Absorption Spectrophotometer method suggested by Bishnoi and Brar, 1988.

Free radical scavenging activity

The DPPH (2,2-diphenyl-1-picrylhydrazyl) is a free radical reagent and an easy, precise, and accurate method for the analysis of free radical scavenging activity of the food product. The 2, 2-diphenyl-1-picryl-hydrazyl produces a violet solution in alcohol. It is reduced in the presence of an antioxidant molecule. Antioxidant activity of the methanol extract of the developed products and standard were assessed on the basis of the radical scavenging effect of the stable 2,2-diphenyl-1-picrylhydrazyl hydrate radical (DPPH). The diluted working solutions of the test samples were prepared in methanol. Gallic acid was used as the standard in solutions ranging from 5 x 10^{-4} to 4 x 10^{-3} mg ml^{-1}. DPPH solution 0.135 mM was prepared in methanol. Then 2 ml of this DPPH solution was mixed with 2 ml of sample solutions (ranging from 1 mg ml^{-1} to 8 mg ml^{-1}) and the standard solution were tested separately.

These solution mixtures were kept in the dark for 30 min and optical density was measured at 517 nm using ECIL make spectrophotometer against methanol. 2 ml of methanol with 2 ml of DPPH solution was used as control. The optical density was recorded and percentage of inhibition was calculated using the formula ((Saxena *et al.,* 2015 and Shimada *et al.,* 1992)) given below:

% of inhibition of DPPH activity = (A–B/A) × 100

Where, A is optical density of the control and B is optical density of the sample.

The free radical scavenging activity of the methanolic extracts of the test samples were expressed as the IC 50 value (mg/ml) i.e., the concentration necessary to decrease the DPPH concentration by 50%.

Results and Discussion

Proximate composition

Proximate content is an important parameter to assess the basic nutritional quality of any food product. The data on proximate composition (dry weight basis) of four fried snacks based on cowpea are summarized under table 1. Ash content in foodstuff is assessed after destruction of organic matter present in it. Thus it may not necessarily be exactly equivalent to the mineral matter as some changes may occur due to volatilization or some interaction between constituents (Ranganna 1986). The ash content in the developed product was higher and approximately similar in enrobed nuts (4.94%) and *sev* (4.17%) followed by fried nuts (3.29 %) and *boondi* (2.52 %).

Fat provides energy and aids in transport of fat soluble vitamins, insulates and protects internal tissues and contributes to important cell processes (Jones *et al.,* 1985 and Pamela *et al.,* 2005).

The analysed crude fat, with the true fat (triglycerides), other material soluble in ether such as phospholipids, sterols, essential oils and fat soluble pigments are also present in it (Ranganna 1986). Crude fat content was among the cowpea based snacks recorded lowest in fried cowpea nuts (26.74 %) and highest in enrobed nuts (42.42 %).

Crude fiber is the organic residue which remains after the food sample has been treated under standardized conditions with petroleum spirit, boiling dilute sulphuric acid, boiling dilute sodium hydroxide solution and alcohol. The crude fiber consists largely of cellulose together with a little lignin. The crude fiber content was noted higher i.e. 2.95 % in enrobed nuts followed by 1.32 in fried cowpea nuts, 0.73 % in *sev* and 0.55 % in *boondi.*

Protein content in the developed snacks was recorded maximum for enrobed nuts (18.43 %) followed by *boondi* (12.75%), *sev* (11.82 %) and fried nuts (10.25%). Enrobed fried nuts were prepared by enrobing cowpea flour added with spices on roasted peanuts, hence the protein content of enrobed fried nuts were higher.

Table.1 Mean values of proximate composition of the cowpea snacks (gm/100gm)

	Moisture	Ash	Fat	Fiber	Protein	CHO	Energy
Sev	2.01±0.074	4.17±0.034	36.94±0.321	0.73±0.067	11.82±0.602	49.41±0.815	573.31±1.487
Boondi	5.89±0.319	2.52±0.070	34.97±0.922	0.55±0.018	12.72±0.358	55.50±0.927	582.59±4.599
Enrobed Nuts	1.26±0.191	4.94±0.051	42.42±0.207	2.95±0.118	18.43±0.355	32.54±0.583	585.66±0.415
Fried cowpea nuts	1.30±0.151	3.29±0.053	26.74±0.125	1.32±0.067	10.25±0.261	59.71±0.403	520.49±0.397

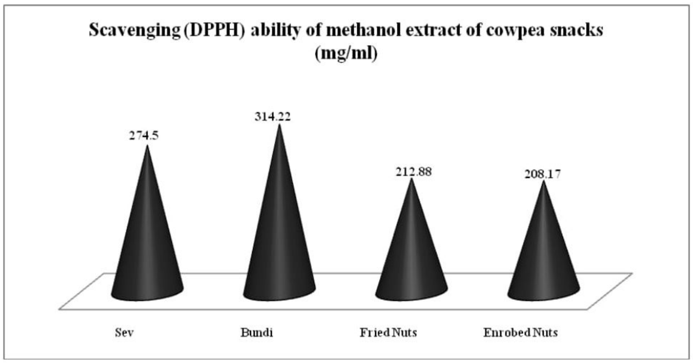
Note: dry weight basis ± Standard deviation

Table.2 Mean values of calcium and iron content in cowpea snacks (mg/100gm)

Cowpea products	Calcium	Iron
Sev	1.75 ± 0.056	7.43 ± 0.107
Boondi	1.38 ± 0.028	5.01 ± 0.087
Enrobed Nuts	1.71 ± 0.124	6.07 ±0.282
Fried Nuts	2.03 ± 0.071	9.14 ± 0.492

Note: dry weight basis ± Standard deviation

Fig.1



Calcium and iron content

The developed snacks were also analysed for calcium and iron content and presented under table 2. Highest calcium and iron content was noted in fried nuts i.e. 2.03 and 9.14 mg/100gm respectively. Marginal difference was noted in calcium and iron content was observed for *sev* and enrobed nuts. The present study reveals that all the developed snacks were rich source of iron content.

Free radical scavenging activity

The determination of the antioxidant activity of cowpea product extract was based on the DPPH radical scavenging activity through the IC_{50} parameter, which represents the concentration of the material necessary to inhibit 50 % of free radicals. Thus, a lower IC_{50} value shows a superior ability to neutralize free radicals and potential antioxidant content. The scavenging ability of methanol extract of the cowpea snacks are represented as IC_{50} of DPPH radical is shown in Fig 1. Enrobed nuts followed by fried cowpea nuts had 208.17 mg/ml and 212.88mg/ml free radical scavenging activity respectively. The results of the present study revealed that the fried snacks also exhibit the antioxidant property.

Kushwaha and co-workers in 2014 developed *khajure* and *mathri* snacks were supplemented with cowpea and wheat flour in different combinations. It was noted that *khajure* and *mathri* prepared by incorporation of cowpea flour were most acceptable up to levels of 40% and 20%, respectively. Further they computed the nutrient composition of cowpea incorporated products and concluded that cowpea supplemented food products may be utilized for solving the problem of protein energy malnutrition among young children in developing countries.

Various studies conducted on cowpea revealed that it an incredible source of many other health-promoting components, such as soluble and insoluble dietary fiber, phenolic compounds and minerals (Liyanage *et al.,* 2014; Mudryj *et al.,* 2012). These nutrients help in improving the quality of human health by offering a number of health benefits. Several studies revels that the consumption of cowpea exerts protective effects against the development of several chronic diseases. Snacks prepared by using cowpea as base ingredient could offer an overall improvement of nutritional status and there by healthy individual especially the young Indian population.

In conclusion this study showed that the cowpea snacks are good source of protein, energy, minerals and exhibits antioxidant activity. Formulation of snacks by using cowpea flours or seed is a major step towards alleviating protein energy and iron malnutrition as most of children and adolescents depend on fried snacks. Children need the protection which is provided by the foods with antioxidant activity. The consumption of cowpea snacks would make some contributions to health promotion and protection required with the advancement in age.

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Current Uses and Future Prospects of Ginger Processing and Entrepreneurship Development among Farm Families

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ABSTRACT

Ginger processed products were developed in the Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The present study was conducted to assess the quantity of ginger used in production and final utilization of ginger. Need assessment for ginger processing skills and training was done to ensure livelihood security. An extensive survey was conducted in Bhimtal block, Nanital District, Uttarakhand. Total 50 farmers were selected and interviewed through structured questionnaire for data collection. The study revealed that 75.0 per cent of the farmers were growing ginger and 67.57 per cent of farmers using 2 to 25 kg as ginger seeds. During peak season, the selling price of ginger ranged between Rs. 30/kg to 80/kg. However, the price of ginger varies widely with production. Eighty four per cent of the farmers were ready to prepare these products, however 64 per cent wanted to sell ginger *sherbet* in market. Out of 43 farm women trained, only 4 female (with adoption rate 9.30 %) adopted this as a business. Hence, processing of ginger may help in increasing the farmers' income.

Key Words: Employment, Processing, Spices, Household Consumption, Entrepreneurship.

INTRODUCTION

Ginger (*Zingiber officinale* Rose.) is an important commercial spice crop in tropical and subtropical region (Ambia, 2006). The rhizome is used worldwide as spice for flavouring in a number of foods and food-products and also used in medicine. Ginger used in traditional medicine, has been found to possess antioxidant effect that can control the generation of free radicals (Ahmad *et al,* 2006). The main bioactive components of ginger possess antioxidant, anticancer, and anti-inflammatory attributes (Malu *et al,* 2009 and Ghasemzadeh, 2010). It is effective for the treatment of inflammation, rheumatism, cold, heat cramps, and diabetes (Al-Amin *et al,* 2006 and Afshari *et al,* 2007). Several studies suggest that ginger may work better than placebo in reducing some symptoms of motion sickness.

Uttarakhand, located at the foothills of the Himalayas, is characterized by diverse geographical features ranging from snow-capped mountain peaks in the North to tropical forests in the South. This complete region is divided in 4 agro climatic zones *i.e.* Zone A (lower hills up to 1000 m), Zone B (mid hills 1000-1500m), Zone C (high hills 1500-2400m), Zone D (very high hills > 2400 m). Major spices are ginger, garlic, turmeric and chilly. In India, Uttarakhand ranks 6th in production of ginger with productivity 9.66 MT/ha in the 2015-16. The major producing belts in the state are Almora and Tehri. In hilly regions, major wildlife agents responsible for crop damage are wild boar, bear, porcupine, monkey, musk deer and partridge. Monkey and wild boar alone accounted for about 50 to 60 per cent of total crop damage. Potential solutions needed to undertake suitable and appropriate protective measures to minimize the crop losses.

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Fresh ginger is seasonal, perishable in nature and available in large quantities during the peak season in the local market. After harvesting it cannot be kept for longer period due to higher water activity and during storage it suffers from weight loss, shrinkage, rotting and sprouting. Due to lack of processing and value addition practice in ginger, during harvesting season, a huge quantity of fresh produce becomes unmarketable (Nath *et al*, 2013). Diversified use in the form of processed ginger products may help in efficient utilization of its production and ultimately reduces the post harvest losses. Ginger enters the market in six forms, which are used in different cuisines: these include fresh ginger, dried ginger, pickled ginger, preserved ginger, crystallized ginger and ground ginger (www.spice-trade.com, 2009). Fresh ginger comes in mature and immature forms. Both mature and immature rhizomes are consumed as fresh vegetable. Preserved ginger is made only from immature rhizomes. Fresh ginger is also available with garlic and most popularly known as ginger garlic paste. The most important commercial form is dried ginger followed by preserved ginger, while fresh ginger is of least commercial significance. However by processing of fresh ginger in various forms of processed products may enhance its commercial significance.

In hilly areas the size of farms is small and farmers grow ginger in small amount for household consumption. When the production is more than requirements then it gets wasted due to germination. Hence skills related to the processing of ginger especially in area of its production may be helpful in gainful employment for farmers. Keeping

Table1. General information, production and utilization of ginger by farmers of the studied area.

Sr. No.	Particular	Respondents General information	
		Frequency	Percentage
1	Gender		
	Male	13	26.0
	Female	37	74.0
2	Age		
	Young (up to 28 yr)	18	36.0
	Middle (29-38 yr)	15	30.0
	Late middle (39-48 yr)	7	14.0
	Old (49 yr and above)	10	20.0
3	Education		
	Primary	19	38.0
	High school/ intermediate	25	50.0
	Graduation	5	10.0
	Post Graduation or other	1	2.0
4	Occupation		
	Un employed	18	36.0
	Agriculture	22	44.0
	Employed (Gov./Privet sector)	6	12.0
	Student	6	12.0

Table 2. Ginger production and its utilization by the famers.

Sr. No.	Particular	Ginger production and its utilization by the respondent	
		Frequency	Percentage
1	Grows ginger	37	74.0
2	Production of ginger		
	Below 50 kg	9	24.3
	50kg – 100kg	9	24.3
	100kg - 150kg	4	10.8
	150kg -200kg	4	10.8
	Above 200kg	11	29.7
3	Use of ginger		
	Self consumption	37	100.0
	For seed	33	89.1
	For sale	24	64.8
	Sent to relatives	19	51.3
4	Form of ginger consumption		
	Tea	50	100.0
	Vegetable	36	72.0
	Dried/*Sherbet*/Candy	0	00.0

this in view survey was conducted to know the consumption and utilization pattern of ginger by the farmers and need assessment for the processing of ginger was undertaken in Uttarakhand.

MATERIALS AND NMETHODS

Three ginger products *viz., sherbet*, candy and toffee were developed. Ginger powder was the by-product while processing of ginger for *sherbet*. All the products were standardized at Department of Foods and Nutrition, College of Home Science GB Pant University of Agriculture and Technology. A survey was conducted among the farmers in Bhimtal, Nanital District of Uttarakhand. The area for study was selected on the basis of ginger production data and feasibility for follow-up of these farmers. The respondents were selected randomly from Lamjal, Bhurjala and Suryajal villages from Bhimtal. Structured questioner was prepared and all the respondents were interviewed for reliable data. The questionnaire was divided into three parts viz. General information of the respondents, ginger production, it's utilization and perception on ginger processed products and skills. On the basis on farmers' interest in processed products of ginger one day training programme was conducted at Lamjala and Gathiya village of Bhimtal. Impact of the training was recorded in terms of gainful self employment.

RESULT AND DISCUSSION

General information

The data on general information (Table 1) revealed that 74 per cent of the respondents were female, young followed by middle and old aged. The average age of the respondent was 36.12 yr which was in range of the studies focus on entrepreneurs 35 to 45 yr (Bruhn and Zia, 2012; Premand *et al,*

Table3. Perception of respondent on the processed ginger *sherbet*.

Sr. No.	Particular	Perception of respondent on the processed ginger *sherbet*	
		Frequency	Percentage
1	Liking of the products		
	Extremely	13	26.0
	Too much	33	66.0
	Like Moderately	4	08.0
2	Want to get training for ginger processing	42	84.0
3	Willingness to adopt as business	32	64.0
4	Knowledge of the regulatory bodies working for food products		
	Yes	11	22.0
	No	13	26.0
	No response	27	54.0

2012). The education data showed that 50.0 per cent of the respondent was high school passed and 38 per cent was primary educated.

Ginger production and utilization

It was observed that currently 74 per cent of the farmers were growing ginger (Table 2) and 24.32 per cent were growing below 50kg. In terms of ginger consumption it was noted that all the respondent were consuming ginger in tea followed by curry preparation (72.0%). During peak season, the selling prices of ginger ranged between Rs. 20/kg to 80/kg. All the prepared ginger products were liked very much by the farmer. The farmers were ready to prepare the products and sell them in market. Hence both products may help in increasing the farmers' income.

Perception on ginger processed products

It was noticed that ginger products were liked extremely and too much by 26.0 per cent and 66.0 per cent of the respondent, respectively (Table 3) 84.0 per cent became interested to acquire training for ginger *sherbet* making.

Training and its impact

On the demand of farmers, one day method demonstration was given to the 43 farm women. Impact of the training was recorded in terms of adoption rate of ginger processing technology in the form of product preparation and selling by these trained farmers in local market. After training four farm women were inspired to make ginger candy and *sherbet* and adopted the technology for income generation. Two days intensive training was given to these farm women. Initially 6 kg ginger was processed per day for *sherbet* making. The products were sold with the profit of more than 50 per cent. For ginger candy 6 kg ginger was processed twice a week. This was also sold with the profit of 50 per cent (table 4). By products such as ginger pulp and peel was dried by these adopters and consumed as a "*masala*" for tea.

CONCLUSION

Entrepreneurship related to food processing has been named as one of the key driver for economic growth of farmers and rural youth. Entrepreneurship has been linked to amplified growth, increased aggressiveness of countries, increased creation of wealth and increased quality of life. In developing countries like India training programmes related to food processing skills are essential for especially

Table 4. Cost production of ginger *sherbet* and candy:

Parameters	Details for candy	Details for *sherbet*
Assumption	25 working days in a month and one shift of 8 hr/day.	25 working days in a month and one shift of 8 hr/day.
Cost of raw material	Rs. 6,000/- (6 kg ginger/ week)	Rs. 64,500/- (6 kg ginger/working day)
Wages of worker per month	Rs. 5,000/-	Rs. 10,000/-
Total Production	800 (packed in 30gm/ Packet)	875 litters (packed in 200ml/bottle)
Total Cost	Rs. 11,000/-	Rs. 74,500/-
Total turnover/ month	Rs. 22,000/-	Rs. 1,49,000/-
Net Profit per month	Rs. 11,000/-	Rs. 74,500/-

for small farmers because of their over-dependence on agriculture for employment. Such farmers has less produce to handle hence food processing related skills would be highly beneficial in terms of economic growth and develop livelihood security specially among the small farmers. Thus entrepreneurship development in rural industries appears to be the best potential alternative to find employment avenues for the rural population.

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Entrepreneurship development in rural area by processing of ginger

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Ginger an Indian spice: Many Indian spices play a significant role in food preparation and act as an important ingredient. Every spice has its own flavour and essence which helps in making that spice unique and thereby delicious dish. Apart from making food tasty, spices also come with notable nutritional values and provide some major health benefits. Spices have a traditional history of use, with strong roles in cultural heritage. Ginger (*Zingiber officinale* Rose.) is one of important commercial spice crop in tropical and subtropical region. The rhizome is used worldwide as spices for flavouring in a number of food-products and also used in medicine. Apart from being a spice in a recipe, ginger can be used as processed products such as ginger *Sherbet*, candy, pickle, etc. Ginger used in traditional medicine, has been found to possess antioxidant effect that can control the generation of free radicals. The main bioactive components of ginger possess antioxidant, anticancer, and anti-inflammatory attributes. It is effective for the treatment of inflammation, rheumatism, cold, heat cramps and diabetes. Several studies suggest that ginger may work better than placebo in reducing different health related issues.

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Food processing skills an alternative of unemployment: Presently India is facing the problem of unemployment. Youth unemployment rate in India increased to 23.70 per cent in the fourth quarter of 2018 from 23.10 per cent in the third quarter of 2018. Youth unemployment rate in India averaged 23.23 per cent from 2018 until 2018, reaching an all time high of 23.70 per cent in the fourth quarter of 2018 and a record low of 22.90 per cent in the second quarter of 2018 (*https://tradingeconomics.com/india/youth-unemployment-rate*).

Foods grown locally can provide a solution to the problem of food and nutritional security. For this it is necessary to provide training on skills related to primary and secondary processing of these foods. Such trainings would empower rural women and small farmers for development of value added products and ultimately leads to livelihood support for them. Through this tool, the problem of unemployment and food security would be addressed together. Besides this food processing enhances utilization of these crops, reduces transportation cost and post harvest loss due to spoilage. Above all this act will help in dealing with nutritional security and at the same time local people will not migrate to other place for job searching. India is second largest country in terms of population. Here work force or manpower to work is available as well as consumers are also present. This is urgent need to link up both for production of the food as well as consumption of the processed foods. By doing so, lots of the problems could be resolved together.

Ginger based enterprise: Fresh ginger is seasonal, perishable in nature and available in large quantities during the peak season in the local market. After harvesting it cannot be kept for longer period due to higher water activity. During storage ginger suffer from weight loss, shrinkage, rotting and sprouting. Due to lack of processing and value addition practices in ginger, after harvesting season, a huge quantity of fresh produce becomes unmarketable. More than 50 per cent of total ginger production takes place in North East, Uttarakhand and Sikkim states. In Uttarakhand region small farmers grow ginger in smaller amounts for household consumption. Production of such ginger is very less and ranged between 50 to 100 kg per household. Such amount of ginger is not enough to transport for sale in market from hilly tertian where transportation cost are high but it is more than enough for household consumption. It was observed that population of hills and near by area of Uttarakhand was consuming ginger throughout the year. Keeping all this in view the technology on ginger processing and product development was given to twenty farm women at Lamjala village, Bhimtal, Nainital.

Material required for processing: Processing material could be divided in two parts *i.e.* recurring goods such as ginger, citric acid, preservative (KMS), labels, packaging material etc. Non-recurring goods such cap crowning machines, stainless steel utensils, etc. These materials may vary according to the capacity of processing unit for example with increasing in processing capacity, one ginger washing and peeling machine could be purchased. Initially it is recommended to start work with least materials and equipments.

Development of ginger products: Ginger *Sherbet* was prepared and standardised at the Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar. Ginger pulp and peel was by products. Hence, dried ginger pulp was also preserved in dried form.

Technology provided: Standardised ginger *Sherbet* was given to the farm women to taste. Need assessment, novelty and perception to develop the product was done to achieve the maximum adoption for processing of ginger *Sherbet*. Ginger *Sherbet* was very much liked by the trainees. On the demand of farmers, one day method demonstration was given to the 20 farm women in collaboration with the KVK, Jeolikote. Farm women were inspired to make ginger *Sherbet*. Among these two farm women, *i.e.* Mrs. Durga Devi W/O Late Rajender Singh Jantwal and Mrs. Rama Devi W/O Kundan Singh Jantwal wanted to take intensive training to develop ginger *Sherbet*. Keeping this in view, two days intensive training was given to these farm women at the Department of Foods and Nutrition, College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar.For development of ginger *Sherbet* mainly two equipments were required *i.e.* mixer grinder and other was cap crowning machine. These women had the mixer grinder, however, cap crowning machine was provided by the Department of Foods and Nutrition, College of Home Science. In beginning raw material was provided with the help of UGC's project "Agribusiness module of value added underutilized food products towards livelihood support of hill states". Initially 6 kg ginger was processed per day for *Sherbet* making. The profit could be increased by selling of dried ginger pulp also. This dried ginger pulp had a mild flavour hence, it may be utilized as ingredient in bakery products, ice-creams and other product preparation. In case of candy, 5 kg ginger was processed per week. Candy required more time as compared to *Sherbet*. Both the products were sold with the profit of more then 50 per cent. Table 1 shows the production cost calculation for ginger *Sherbet* and candy, respectively.

Impact of technology: The results depicts that processing of 6 kg ginger per day for 24 days working in a month is a

Table 1: Cost production of ginger sherbet and candy

Parameters	Details for *Sherbet*	Details for candy
Assumption	25 working days in a month and one shift of 8 hours/day	25 working days in a month and one shift of 8 hours/day
Cost of raw material	Rs. 64,500/-	Rs. 3,000/-
Salaries/ wages of worker per month	Rs. 10,000/- (5,000 per person and 2 persons will be required)	Rs. 5,000/- (5,000 per person and 1 persons will be required)
Total production	875 litters (packed in 200ml/bottle)	400 (packed in 50g/ Packet)
Total cost	Rs. 74,500/-	Rs. 8,000/-
Total turnover/ month	Rs. 1,49,000/-	Rs. 16,000/-
Net profit per month	Rs. 74,500/-	Rs. 16,000/-

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profitable household business. Adoption rate was 10 per cent of the technology. The profit margin may increase upto 100 per cent with increase in scale processing. This technology does not require specific equipments, hence, very much suitable to the farmers. Nainital is one of the most popular tourist city as well as its climatic condition is cold. In this climatic condition people like to take ginger *Sherbet* for both health and taste reason.

Conclusion: It could be concluded that processing of ginger is a profitable business for youth as well small scale ginger growers. Hence, the processing of ginger for *Sherbet* and candy making could be more viable and profitable business for the state like Uttarakhand. Consumption of ginger in cold area is higher than the rest of the parts in India.

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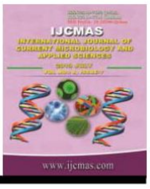

Original Research Article

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Farm Based Processing of Ginger Products and Perception of Small Vendors for Commercialization

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ABSTRACT

Small vendors play very important role in urban India by providing the products related to routine life. Through this way these small vendors helps in generating income to them as well as the producers of these products. Hence for product commercialization, perception about the product of these small vendors plays also important. Keeping this thing in view a survey was conducted among small vendors to know the perception in commercialization of these products. The study was carried out among small vendors at Udham Singh Nagar, Uttarakhand. Selection of respondent was done on the basis of the willingness of vendors to be part of the study and feasibility of the researcher. Total 38 small vendors were surveyed and it was observed that organoleptically both the products were acceptable. As per the results of organoleptical assessment it was found that 76.38 per cent of respondents were liked ginger sherbet where as ginger candy was liked by 81.69 per cent of respondents. It was also observed that 81. 58 per cent 84.21 per cent were agree to keep the ginger sherbet and ginger candy with other products for sell, however 84 per cent of vendors were did not like to prepare and sell both the products due to various reason. Study also revile that small vendors were not open to accept new product for preparing and sell.

Keywords

Ginger (*Zingiber officinale* Rose.), Organoleptical

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Introduction

Ginger (*Zingiber officinale* Rose.) is an important commercial spices crop in tropical and subtropical region (Ambia, 2006 and Rahim 1992). The rhizome is used worldwide as spices for flavouring in a number of foods and food-products and also used in medicine. Ginger used in traditional medicine, has been found to possess antioxidant effect that can control the generation of free radicals (Ahmad, *et al.,* 2006). The main bioactive components of ginger possess antioxidant, anticancer, and anti-inflammatory attributes (Malu, *et al.,* 2009 and Ghasemzadeh, 2010).

It is effective for the treatment of inflammation, rheumatism, cold, heat cramps, and diabetes (Al-Amin, *et al.,* 2006 and Afshari, *et al.,* 2007). Several studies suggest that ginger may work better than placebo in reducing some symptoms of motion sickness.

Fresh ginger is seasonal, perishable in nature and available in large quantities during the peak season in the local market. After harvesting it cannot be kept for longer period due to higher water activity and during storage it suffer from weight loss, shrinkage, rotting and sprouting. Due to lack of processing and value addition practice in ginger, during harvesting season, a huge quantity of fresh produce becomes unmarketable (Nath *et al.,* 2013). Ginger is normally stored in pit but within few days sprout and roots are found. For export the minimum rhizome size is 250 g whereas there is no maximum size limit. A large rhizome with limited branching is requiring as per the market demand. Rhizomes having more than 4 side branches should not preferred for export. The main stem of 3 cm (1.25 in) thick and 12 cm (5 in) long is preferred. Export quality ginger should be smooth and firm, having tight and light brown skin with uniform shape and size, be free from insect damage and decay (Bag. 2018).

More than 50% of total ginger production takes place in North East, Uttarakhand and Sikkim states (http://agriexchange.apeda.gov.in/Market%20 Profile/one/GINGER.aspx). In Uttarakhand region small farmers grow ginger in fewer amounts for household consumption. Production of such ginger is very less ranged between 50 to 100 kg. Such amount of ginger is not enough to carry for sell in market but it is more than enough for household consumption.

In the era of globalization, the retail sector is the fast growing emerging sector after agriculture. Small retailing including street vending has been one of the easiest ways to sell the new products. Street vendors are providing the market for home-based manufacturing product especially processed agricultural products. In this way, street vendors help sustain employment in these home-based, small-scale industries and traditional sector. Besides the employment context, street vendors also support urban rich and urban poor. Street vendors prop up urban rich to provide daily requirements as available on their doorsteps because some street vendors built up their profession in front of housing complexes. These small vendors plays key role in commercialization of new products and hence perception of these small vendors is important.

Keeping all this in view the present study was conducted to know the perception of ginger based products among small vendors and for commercialisation these products.

Materials and Methods

Procurement of raw material and product formulation

Fresh ginger and other material were procured from raw material from the local market. Fresh ginger was used for product development. It was selected and collected according to their uniform size, freshness and cleanliness (free from dirt, twigs, soil, dust). The gingers were then washed to clean the dirt and washed gingers were peeled to remove outer layer. Peeling was done and time utilized and weight of peel was recorded. Ginger was cut into around 1to 3 cm pieces.

Commercialization and perception of small vendors

The survey study was conducted among small vendors at Udham Singh Nagar, Uttarakhand. Selection of respondent was done on the basis of the willingness of vendors to be part of the study as well as feasibility of the researcher. Structured questioner was prepared to assess awareness, acceptance and willingness of shopkeepers' to sell ginger products. Total 38 small vendors were surveyed. Packed ginger sherbet and ginger candy was shown to small vendor. Ginger products were given to small vendors for organoleptic acceptability and perception of the small vendors about the products.

Cost evaluation of the ginger products

This was done to evaluate the net profit to the small farmers.

Results and Discussion

Product formulation

Ginger Sherbet and candy was developed in the laboratory to standardise the product. For this the different permutation combination were used in preparation of the proposed and sensory evaluation was done. Sensory evaluation of the product was done by semi trained panel members. Ginger sherbet and candy was prepared by using standardized procedure and packed in 200 ml bottles and 50 grams for candy.

Commercialization and perception of small vendors

Over all acceptability of the product by the small vendors is presented under the table 1. The overall acceptability of Ginger sherbet was liked maximum i.e. liked extremely (28.95 percent) followed by liked moderately. Results of organoleptic evaluation indicate that 76.32 per cent of the small vendors liked ginger sherbet. Total 81.58 per cent of the respondent liked ginger candy. Small vendors said that such kind of ginger products were new for them. The reason of not liking the product was that these vendors personally did not like ginger flavour and believed that this product could sell in winter only.

The total 81.58 per cent and 84.21 per cent of small vendors were wanted to sell the prepared ginger sherbet and candy respectively (Figure 1). More per cent of small vendors were wanted to sell ginger candy as it doesn't need further preparation. For sherbet it has to dilute further either in cold or hot water.

Maximum number (i.e. 84 per cent) of small vendors were did not like to prepare and sell both the products. Reason for not preparing and selling the product was majorly time constrain or other work (84.38 per cent). Other works were included house hold work, animal rearing etc. However 9.38 per cent of the shopkeepers were satisfied with present work. These vendors were selling different products such as *golgappas, tikki* and noodles etc. These vendors informed that *golgappas, tikki* and noodles etc are very much know and highly acceptable to the consumers. This was also observed that the small vendors were more concern about the acceptability of the products among other consumer as these products were new in market.

Soam and Hussain (2011) conducted a survey in 25 states of India identified promising indigenous drinks. Manufacturing procedures of these drinks was community traditional knowledge. Product acceptability by the retailers and consumers was high, hence companies would be willing to invest in such products. One of the important issues to be addressed is benefit sharing with traditional knowledge holders and alleviation of their socio-economic condition.

Cost evaluation of the ginger products

Cost assumption by small vendors was also recorded. Primarily vendors said that the cost has to be calculated on the basis of inputs used in product formulation. Ready to serve (RTS) ginger sherbet could be sold at 15 to 35 Rs/ 200 ml of glass bottle.

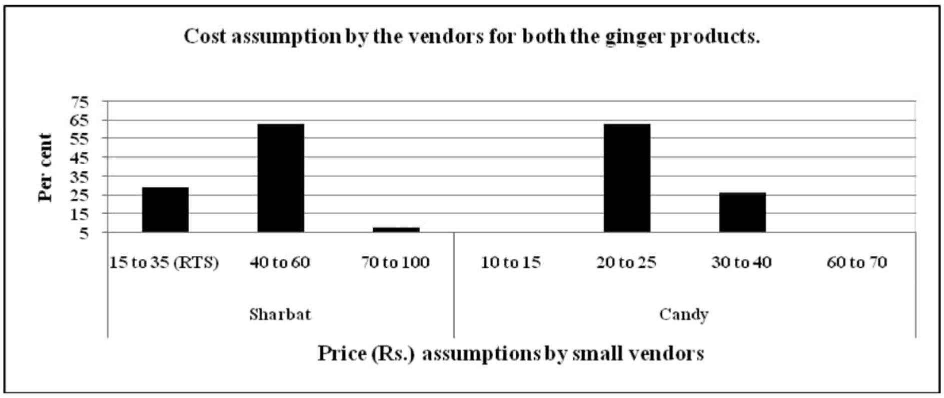
Table.1 Over all organoleptic score of ginger sherbet and ginger candy

Sensory Scores	Sherbet, n (%)	Candy, n (%)
4(Dislike moderately)	1 (2.63 %)	1 (2.63 %)
5 (Dislike slightly)	2 (5.26 %)	3 (7.89 %)
6 (Neither like nor dislike)	6 (15.79 %)	3 (7.89 %)
7 (Like slightly)	4 (10.53 %)	7 (18.42 %)
8 (liked moderately)	9 (23.68 %)	10 (26.32 %)
9 (Like very much)	5 (13.16 %)	7 (18.42 %)
10 (liked extremely)	11 (28.95 %)	7 (18.42 %)

Table.2 Cost production of ginger sherbet and candy

Parameters	Details for sherbet	Details for candy
Assumption	25 working days in a month and one shift of 8 hours/day.	25 working days in a month and one shift of 8 hours/day.
Cost of raw material	Rs. 64,500/-	Rs. 3,000/-
Salaries/ wages of worker per month	Rs. 10,000/- (5,000 per person & 2 persons will be required)	Rs. 5,000/- (5,000 per person & 1 persons will be required)
Total Production	875 litters (packed in 200ml/bottle)	400 (packed in 50gm/ Packet)
Total Cost	Rs. 74,500/-	Rs. 8,000/-
Total turnover/ month	Rs. 1,49,000/-	Rs. 16,000/-
Net Profit per month	Rs. 74,500/-	Rs. 16,000/-

Fig.1 Cost estimated by the vendors for both the ginger products



For 200 ml of sherbet cost estimated by vendors was ranged between 40 to 60 Rs/ bottle (Fig. 1). However in market different squash and sherbet are available in the packaging of 750 ml and the cost range between Rs 120 to 170. Cost of various popular brands of carbonated drinks were ranged between Rs. 90/ 2.25 litters to Rs. 30/600ml. These carbonated drinks are not good for health. Now a days costumer are more conscious for health and willing to consume healthy foods

Formulation of ginger sherbet and candy was evaluated for techno-economic aspects. Expenditure on different parameter for the formulation of ginger sherbet and candy is given in the table 2. Machinery cost is not included as in making ginger sherbet and candy as its processing doest require any different kind of equipment.

Capital investment in production and marketing of different processed food products is highest in building followed by machinery and equipments and land at an overall level of the units. There are various other variable factors such as size of land, type of machinery required for the processing of the food product (Singh, 2013; Paila 2009; Nagesh 1990). In production of any product, the total capital invested is direct related to the size of profit (Venkatasheshaiah, 1992).

In present study the cost of hand operated business was calculated and present in table 2. For ginger sherbet one mixer grinder is required to extract juice form the ginger. In general this equipment is available at household level. However one another equipment is required i.e. cap crowning machine, for crowning of the ginger sherbet bottles. This equipment was made available to the producer at the time of packaging by the Department of food and nutrition, College of Home Science, GB Pant University of agriculture and technology.

In sherbet processing it was noticed that in one very small scale enterprise or nano scale processing unit will accommodate two persons for unit operation. For candy processing it was observed that single person will required for the operation of preparation. Both the products manufacturing is 100 per cent profitable. Increment in production will required the equipments for peeling and other processing activities. Providing employment opportunity to the people is the greatest task to the government. Therefore the people develop their entrepreneur skill to earn income for their livelihood. Street vending is one of the entrepreneurship, small in terms of capital and size and easy to start the business. Nonetheless, it is noticed that there has been a phenomenal increase in the number of street vendors leading to an increase in the number of workers in the informal sector in India and metro cities has witnessed for containing highest street vendors among all major cities in India. (Selvakumar *et al.,* 2014)

The products have a sufficient niche market since per capita fruit juice consumption in India is only 20 ml. Market demand is expected to increase from 27.4 to 64 billion rupees by 2020 with 8.9 per cent market growth, with 65 per cent market share restricted to South India. The study offers for indigenous drinks registration and business strategy with sustainable rural livelihood development (Soam and Hussain, 2011).

India contributes only 9.3% to the world total export of ginger. From which India has 50% share in the trade of oil and oleoresin. This indicates that ginger has strong potential for processing in the form of ginger sherbet and candy. The present study revels that small vendors liked the product and it was believed by them that in winters the sell of this product would be very high. However these were not willing to participate in production but like to sell the products.

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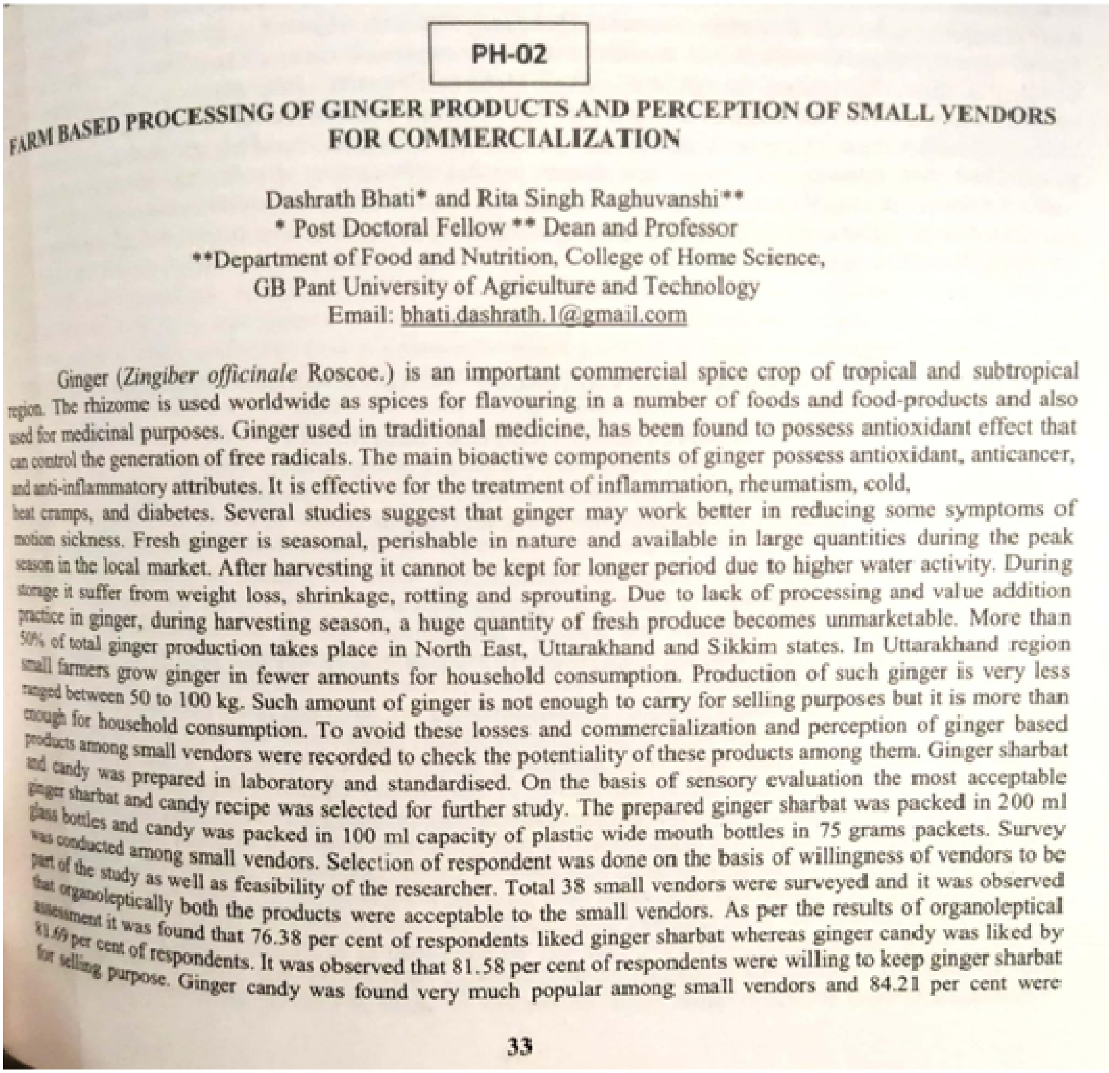
Annexure VII

Paper presented and abstract published in National seminar/ conferences

1. Farmed based processing of ginger products and perception of small vendors for commercialization.9th conference of The Indian Science Congress Association (Haridwar Chapter) on 'Future India: Science and Technology' during October 13-14, 2018. Organized by Department of Biological Sciences, CBSH, GB Pant University of Agriculture and Technology, Pantnagar, US Nagar, Uttarakhand.



PH-02

FARM BASED PROCESSING OF GINGER PRODUCTS AND PERCEPTION OF SMALL VENDORS FOR COMMERCIALIZATION

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Ginger (*Zingiber officinale* Roscoe.) is an important commercial spice crop of tropical and subtropical region. The rhizome is used worldwide as spices for flavouring in a number of foods and food-products and also used for medicinal purposes. Ginger used in traditional medicine, has been found to possess antioxidant effect that can control the generation of free radicals. The main bioactive components of ginger possess antioxidant, anticancer, and anti-inflammatory attributes. It is effective for the treatment of inflammation, rheumatism, cold, heat cramps, and diabetes. Several studies suggest that ginger may work better in reducing some symptoms of motion sickness. Fresh ginger is seasonal, perishable in nature and available in large quantities during the peak season in the local market. After harvesting it cannot be kept for longer period due to higher water activity. During storage it suffer from weight loss, shrinkage, rotting and sprouting. Due to lack of processing and value addition practice in ginger, during harvesting season, a huge quantity of fresh produce becomes unmarketable. More than 50% of total ginger production takes place in North East, Uttarakhand and Sikkim states. In Uttarakhand region small farmers grow ginger in fewer amounts for household consumption. Production of such ginger is very less ranged between 50 to 100 kg. Such amount of ginger is not enough to carry for selling purposes but it is more than enough for household consumption. To avoid these losses and commercialization and perception of ginger based products among small vendors were recorded to check the potentiality of these products among them. Ginger sharbat and candy was prepared in laboratory and standardised. On the basis of sensory evaluation the most acceptable ginger sharbat and candy recipe was selected for further study. The prepared ginger sharbat was packed in 200 ml glass bottles and candy was packed in 100 ml capacity of plastic wide mouth bottles in 75 grams packets. Survey was conducted among small vendors. Selection of respondent was done on the basis of willingness of vendors to be part of the study as well as feasibility of the researcher. Total 38 small vendors were surveyed and it was observed that organoleptically both the products were acceptable to the small vendors. As per the results of organoleptical assessment it was found that 76.38 per cent of respondents liked ginger sharbat whereas ginger candy was liked by 81.69 per cent of respondents. It was observed that 81.58 per cent of respondents were willing to keep ginger sharbat for selling purpose. Ginger candy was found very much popular among small vendors and 84.21 per cent were

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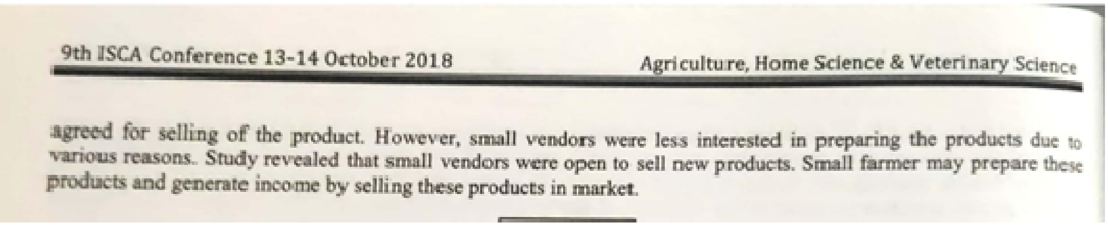
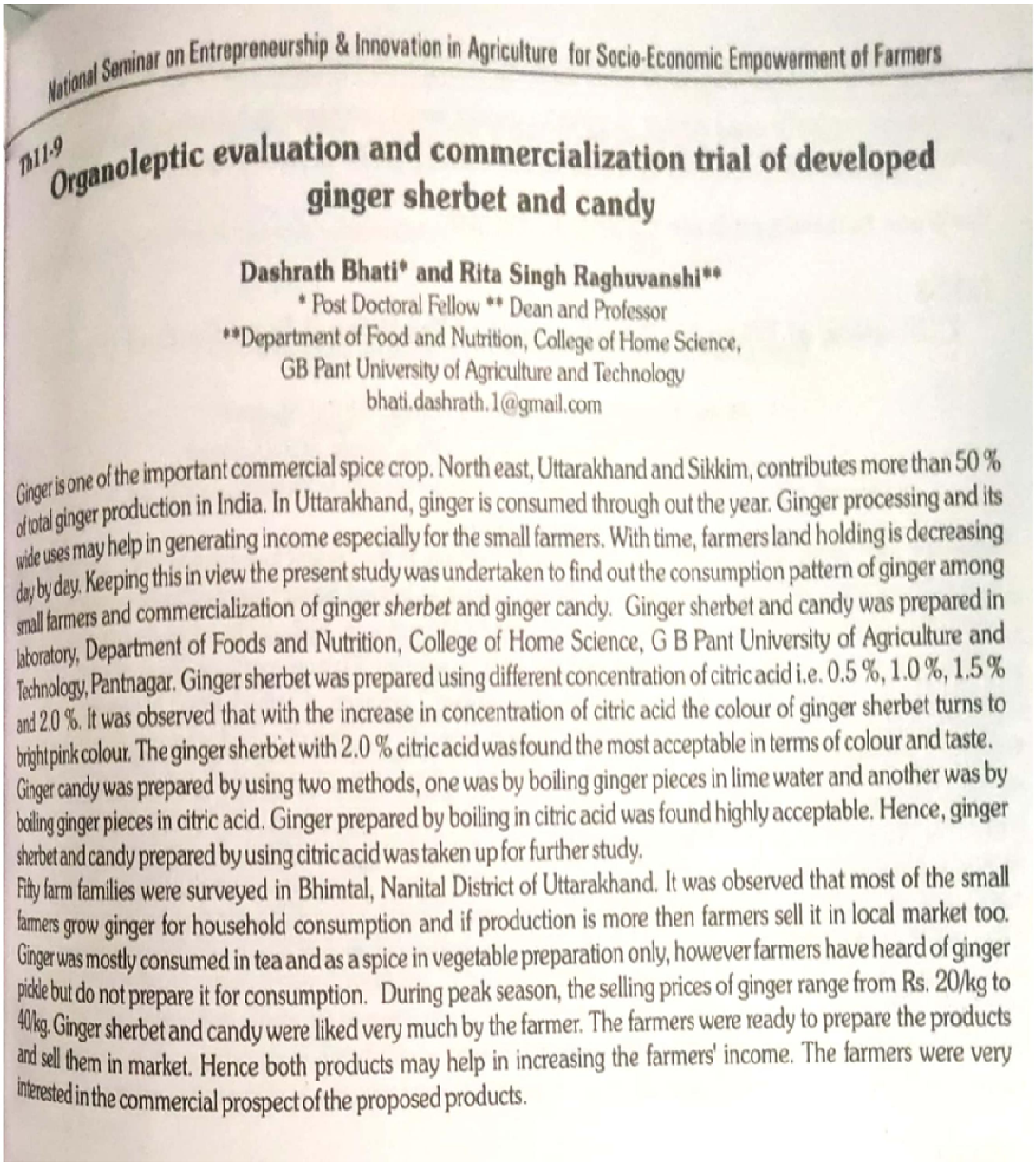


9th ISCA Conference 13-14 October 2018 Agriculture, Home Science & Veterinary Science

agreed for selling of the product. However, small vendors were less interested in preparing the products due to various reasons. Study revealed that small vendors were open to sell new products. Small farmer may prepare these products and generate income by selling these products in market.

2. Organpleptic evaluation and commercialization trial of developed ginger sherbet and candy. National seminar on 'Entrepreneurship and Innovation in Agriculture for Socio-Economic Empowerment of Farmers' during March 12-13, 2019. Organized by Swami Keshwanand Rajasthan Agricultural University, Bikaner.



National Seminar on Entrepreneurship & Innovation in Agriculture for Socio-Economic Empowerment of Farmers

Th11-9

Organoleptic evaluation and commercialization trial of developed ginger sherbet and candy

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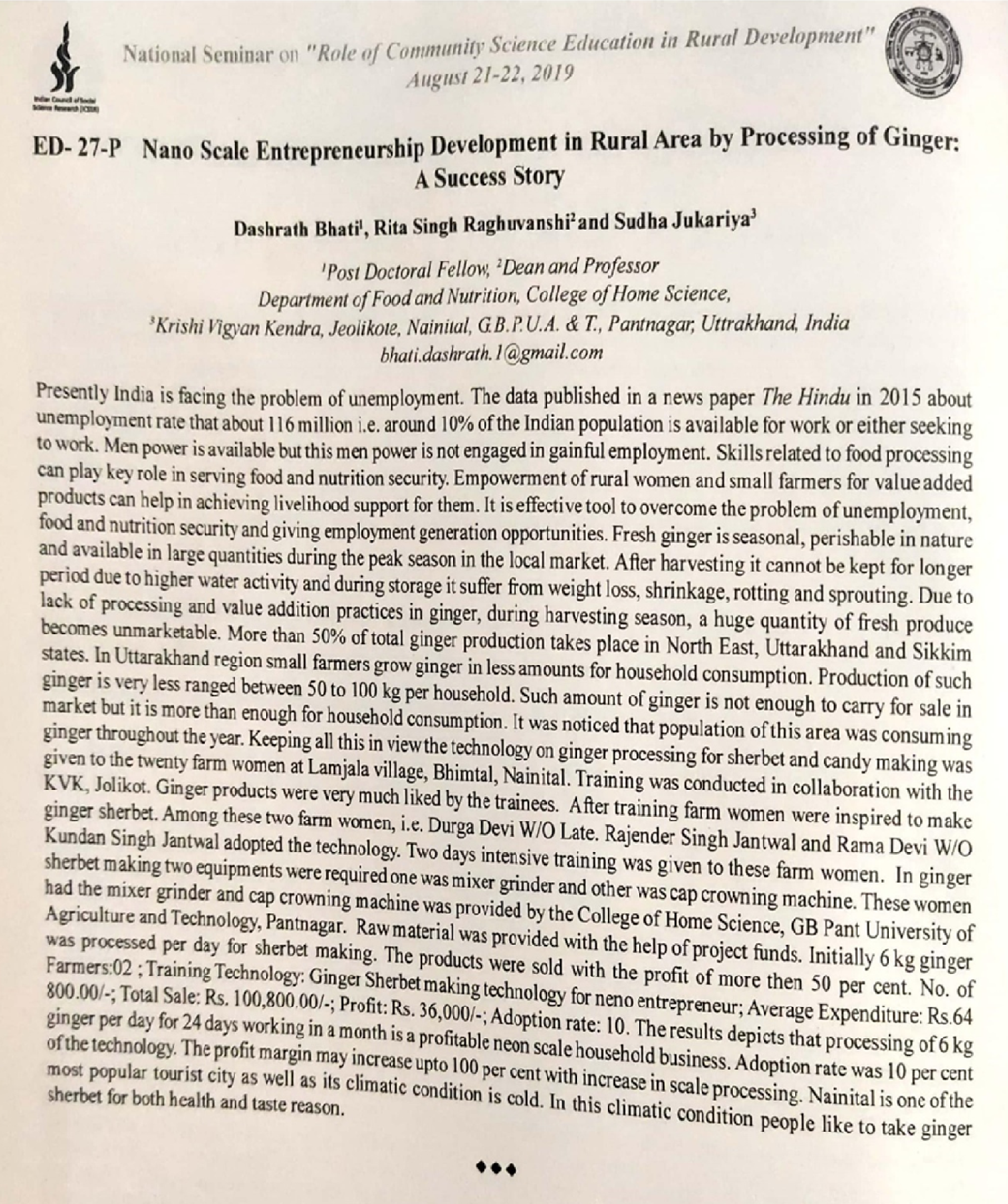
Ginger is one of the important commercial spice crop. North east, Uttarakhand and Sikkim, contributes more than 50 % of total ginger production in India. In Uttarakhand, ginger is consumed through out the year. Ginger processing and its wide uses may help in generating income especially for the small farmers. With time, farmers land holding is decreasing day by day. Keeping this in view the present study was undertaken to find out the consumption pattern of ginger among small farmers and commercialization of ginger *sherbet* and ginger candy. Ginger sherbet and candy was prepared in laboratory, Department of Foods and Nutrition, College of Home Science, G B Pant University of Agriculture and Technology, Pantnagar. Ginger sherbet was prepared using different concentration of citric acid i.e. 0.5 %, 1.0 %, 1.5 % and 2.0 %. It was observed that with the increase in concentration of citric acid the colour of ginger sherbet turns to bright pink colour. The ginger sherbet with 2.0 % citric acid was found the most acceptable in terms of colour and taste. Ginger candy was prepared by using two methods, one was by boiling ginger pieces in lime water and another was by boiling ginger pieces in citric acid. Ginger prepared by boiling in citric acid was found highly acceptable. Hence, ginger sherbet and candy prepared by using citric acid was taken up for further study.

Fifty farm families were surveyed in Bhimtal, Nanital District of Uttarakhand. It was observed that most of the small farmers grow ginger for household consumption and if production is more then farmers sell it in local market too. Ginger was mostly consumed in tea and as a spice in vegetable preparation only, however farmers have heard of ginger pickle but do not prepare it for consumption. During peak season, the selling prices of ginger range from Rs. 20/kg to 40/kg. Ginger sherbet and candy were liked very much by the farmer. The farmers were ready to prepare the products and sell them in market. Hence both products may help in increasing the farmers' income. The farmers were very interested in the commercial prospect of the proposed products.

3. Nano scale entrepreneurship development in rural area by processing of ginger: A success story. National Seminar on 'Role of community science education in rural development', during August 21-22, 2019. Organize by College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar, US Nagar, Uttarakhand.



National Seminar on *"Role of Community Science Education in Rural Development"*
August 21-22, 2019

ED- 27-P Nano Scale Entrepreneurship Development in Rural Area by Processing of Ginger: A Success Story

Dashrath Bhati[1], Rita Singh Raghuvanshi[2] and Sudha Jukariya[3]

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Presently India is facing the problem of unemployment. The data published in a news paper *The Hindu* in 2015 about unemployment rate that about 116 million i.e. around 10% of the Indian population is available for work or either seeking to work. Men power is available but this men power is not engaged in gainful employment. Skills related to food processing can play key role in serving food and nutrition security. Empowerment of rural women and small farmers for value added products can help in achieving livelihood support for them. It is effective tool to overcome the problem of unemployment, food and nutrition security and giving employment generation opportunities. Fresh ginger is seasonal, perishable in nature and available in large quantities during the peak season in the local market. After harvesting it cannot be kept for longer period due to higher water activity and during storage it suffer from weight loss, shrinkage, rotting and sprouting. Due to lack of processing and value addition practices in ginger, during harvesting season, a huge quantity of fresh produce becomes unmarketable. More than 50% of total ginger production takes place in North East, Uttarakhand and Sikkim states. In Uttarakhand region small farmers grow ginger in less amounts for household consumption. Production of such ginger is very less ranged between 50 to 100 kg per household. Such amount of ginger is not enough to carry for sale in market but it is more than enough for household consumption. It was noticed that population of this area was consuming ginger throughout the year. Keeping all this in view the technology on ginger processing for sherbet and candy making was given to the twenty farm women at Lamjala village, Bhimtal, Nainital. Training was conducted in collaboration with the KVK, Jolikot. Ginger products were very much liked by the trainees. After training farm women were inspired to make ginger sherbet. Among these two farm women, i.e. Durga Devi W/O Late. Rajender Singh Jantwal and Rama Devi W/O Kundan Singh Jantwal adopted the technology. Two days intensive training was given to these farm women. In ginger sherbet making two equipments were required one was mixer grinder and other was cap crowning machine. These women had the mixer grinder and cap crowning machine was provided by the College of Home Science, GB Pant University of Agriculture and Technology, Pantnagar. Raw material was provided with the help of project funds. Initially 6 kg ginger was processed per day for sherbet making. The products were sold with the profit of more then 50 per cent. No. of Farmers:02 ; Training Technology: Ginger Sherbet making technology for neno entrepreneur; Average Expenditure: Rs.64 800.00/-; Total Sale: Rs. 100,800.00/-; Profit: Rs. 36,000/-; Adoption rate: 10. The results depicts that processing of 6 kg ginger per day for 24 days working in a month is a profitable neon scale household business. Adoption rate was 10 per cent of the technology. The profit margin may increase upto 100 per cent with increase in scale processing. Nainital is one of the most popular tourist city as well as its climatic condition is cold. In this climatic condition people like to take ginger sherbet for both health and taste reason.

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Annexure VIII

18

अदरक प्रसंस्करण द्वारा बने उत्पाद

दशरथ भाटी[1] एवं रीता सिंह रघुवंशी[2]

1. प्रस्तावना
2. अदरक का उत्पादन
3. अदरक के औशधीय गुण
4. अदरक प्रसंस्करण द्वारा बने उत्पाद
5. भविष्य की सम्भावनाएँ

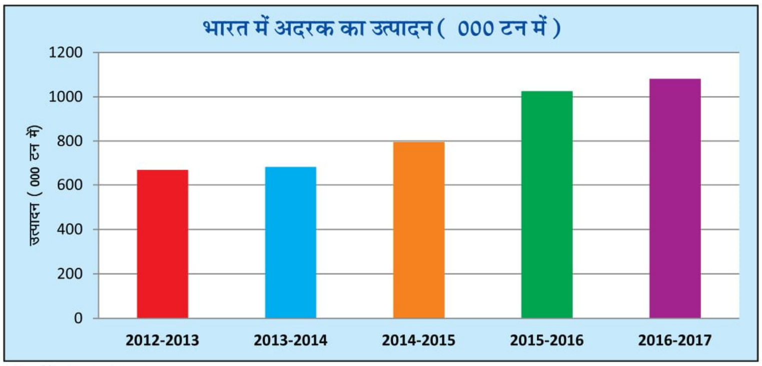
1. प्रस्तावना

अदरक जिन्जीबर ओफीसीनेल (*Zingiber officinals*) जाति के पौधे का रूपांतरित तना अर्थात् प्रकंद है। भूमि के अन्दर उगने वाले इस कन्द को आर्द्र अवस्था में अदरक तथा सूखी अवस्था में सौंठ कहते हैं। अदरक को खुदाई के बाद हरा (गीला) तथा सुखाकर दोनों ही रूपों में काम में लेते हैं। अदरक का उपयोग कच्चे, सूखे चूर्ण परिरक्षित रूप में करी पाउडर, बिस्कुट, अचारों तथा अन्य पदार्थों में खुशबु व स्वाद के लिए प्रयोग में लाया जाता है। ताजे अदरक में लगभग 80 प्रतिशत जल, 2.3 प्रतिशत प्रोटीन, 0.9 प्रतिशत वसा, 2.4 प्रतिशत रेशे, 1.2 प्रतिशत खनिज लवण तथा 12.3 प्रतिशत कार्बोहाइड्रेट पाया जाता है। अदरक में उपस्थित खनिज लवणों में कैल्शियम 710 मि.ग्रा., फास्फोरस 60 मि.ग्रा. तथा लौह तत्व 2.7 मि.ग्रा. प्रति 100 ग्रा. ताजी अदरक से मिलता है। इसमें विटामिन ए, बी और सी भी होते हैं।

अदरक भोजन को पचाने, भूख को बढ़ाने व बलगम को दूर करने, खाँसी, दमा, गठिया जैसे रोगों के इलाज में सहायक है। ताजा अदरक व्यंजनों को खुशबुदार तथा चरपरा स्वादिष्ट बनाने के लिए प्रयोग में लाया जाता है। चाय का स्वाद बढ़ाने के लिए, विशेषकर सर्दियों में अदरक का उपयोग एक आम बात है। अदरक से कैन्डी, मुरब्बा, अचार, चटनी के तथा शर्बत भी बनाए जाते हैं विश्व के कुल अदरक का 50 प्रतिशत भारत में होता है।

2. अदरक का उत्पादन

अदरक प्राचीन काल से ही मसालों के रूप में प्रयोग में लायी जाती है। भारत में अदरक का उत्पादन



http://indianspices.com

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सबसे ज्यादा महाराष्ट्र (209.41), आसाम (163.13), पश्चिम बंगाल (129.02), गुजरात (102.58), कर्नाटक (89.44), मेघालय (65.43), अरूणाचल प्रदेश (56.58), नागालैंड, सिक्किम तथा उडीसा में होता है। विश्व में अदरक के उत्पादन में भारत का दूसरा स्थान है। आजादी के बाद से अब तक अदरक के उत्पादन में लगातार वृद्धि हुई है।

3. अदरक के औषधीय गुण

आयुर्वेद में अनेक बीमारियों में अदरक के उपयोग का वर्णन किया है। प्राचीन समय से अदरक का प्रयोग तरह–तरह की बीमारियों जैसे पेट दर्द, हैजा पेचिश, अपचन, दमा, हृदय रोग, दाँत दर्द, वात सम्बन्धी रोग तथा गठिया आदि में करते रहे हैं। अदरक या इसके रस को कई देशी दवाइयों में डाला जाता है जो मुख्यतः सर्दी जुकाम व पेट सम्बन्धी रोगों में काम आती है, जाती है। अदरक में कुछ ऐसे तत्व होते हैं जो कि पाचन क्रिया को बढ़ाने में मदद करते हैं। पौष्टिक तत्वों के अवशेषों को बढ़ाते हैं, कब्ज को ठीक करते हैं तथा आँतों की माँसपेशियों में होने वाली गति को तीव्र करते हैं। अदरक शरीर में प्रोस्टाग्लेन्डीन तथा ल्यूकोटेरीन के निर्माण को प्रभावित करता है जो कि सूजन को कम करने में प्रभावी है।

अदरक शरीर में रक्त के सही बहाव को बनाये रखने में बहुत उपयोगी होता है। यह हृदय की मांसपेशियों को सुचारू रूप से कार्य करने में मदद करता है। शहद तथा अदरक का रस बराबर मिलाकर चाटने से, बलगमी खाँसी में आराम मिलता है। इसके सेवन से वायु, कफ, खाँसी तथा वात रोग में विशेष लाभ मिलता है। अदरक का रस, नींबू का रस और शहद को पाँच–पाँच ग्राम लेकर अच्छी तरह मिला लें। इस मिश्रण को दिन में तीन बार चाटने से गैस की परेशानी से छुटकारा मिलता है।

4. अदरक प्रसंस्करण द्वारा बने उत्पाद

अदरक को कई तरीकों से प्रसंस्करण कर सकते है जैसे सुखाकर सौंठ के रूप में, स्वादिष्ट पेय बनाकर तथा अचार और चटनी बनाकर।

सौंठ बनाकर

अदरक की धुलाई करने के बाद इसे रातभर स्वच्छ पानी में डुबोकर रखते हैं दूसरे दिन हाथ से ही पानी के अन्दर अच्छी तरह से मसलकर साफ कर लेते हैं। साफ किये हुये अदरक का ऊपरी छिलका बाँस की खपच्चियों से छीलकर उतारते हैं। छिलते समय इस बात का ध्यान रखना अति आवश्यक है कि छिलाई गहरी न हो। छिलाई गहरी होने से वाष्पशील तेल में कमी आ जाती है क्योंकि वाष्पशील तेल मुख्यतः छिलके के ठीक नीचे ही रहता है। चाकू काम में लेने से अदरक का रंग बिगड़ने का डर रहता है तथा इसके इस्तेमाल से छिलाई गहरी होने की सम्भावना होती है। अदरक की कटाई के समय इसमें लगभग 80–82 प्रतिशत जल होता है। उपरोक्त विधि के बाद छिले हुए अदरक को फिर से धोकर धूप में एकल परत बिछाकर सुखाया जाता है। इसके सूखने में लगभग 8–10 दिनों का समय लगता है। इसे तब तक सुखाना चाहिए जब तक कि इसकी आद्रता 10 प्रतिशत से कम न हो जाए। इस प्रक्रिया द्वारा सुखाई गयी अदरक का रंग भूरा तथा इसकी सतह सिकुड़ने के कारण टेढी तथा अनियमित दिखाई पड़ती है।

ताजी अदरक को सुखाने के बाद इसकी 19–25 प्रतिशत सौंठ बनती है। सूखी हुई अदरक को एक रूप दिखाने के लिए इसको घर्षण द्वारा चमकाया जाता है। इस के उपरान्त इसके रंग तथा आकार के अनुसार इसकी ग्रेडिंग की जाती है।

अदरक को सफेद करने के लिए इसे विरंजित (Bleached) किया जाता है। इसके लिए अदरक का छिलका उतारने के बाद इसे 2 प्रतिशत चूने के पानी में 6 घण्टे के डुबाकर रखा जाता है। तथा इसके बाद इसे 8–10 दिनों के लिए सुखाया जाता है। इस क्रिया के बाद सूखी हुई अदरक का रंग हल्का भूरा क्रीमी होता है। यदि अदरक को मशीन में सुखाया जाए तो इस बात का विशेश ध्यान रखे कि इसका तापमान 60°C से अधिक ना बढ़े।

चूने के प्रयोग के बाद सूखी हुई अदरक बनावट में ज्यादा अच्छी दिखाई देती है तथा कीट व अन्य परोपजीवियों के आक्रमण की सम्भावना भी कम हो जाती है।

सूखी हुई अदरक को यदि बोरियों में भर कर इसका भण्डारण करने से इसमें लेसोडरमा सेरिकोन (*Lasioderma serricone*) नामक कीट लगने की सम्भावना बढ़ जाती है। पूर्णरूप से सूखी हुई अदरक को वायुरूद्व डब्बों में, मोटे घनत्व वाली पॉलीथीन या इसी प्रकार के किसी अन्य पदार्थ में पैकेजिंग करनी चाहिए। यदि अदरक को लम्बे समय तक भण्डारित करके रखा जाए तो इसकी खुशबू, स्वाद तथा तीखेपन में कमी आने लगती है।

अदरक मुरब्बा

इसके लिए बड़े तथा कम रेशे वाली अदरक का प्रयोग करना चाहिए। अदरक को धोकर छील लें तथा इसके 1–2 सें.मी. मोटाई के टुकड़े काट लें। इन टुकड़ों को 1 घण्टे ऊबालें ताकि यह नरम हो जायें, पानी फेंक दें। अदरक के बराबर चीनी ले (1 किग्रा. अदरकः 1 किग्रा. चीनी) इसमें थोड़ा पानी डालकर चीनी को घोल लें। इस घोल में अदरक के मुलायम टुकड़े डाल कर पकायें। इसे तब तक पकायें जब तक कि इसका ब्रिक 70° पर न आ जायें। इसे ठण्डा करके जार में भर लें, अदरक मुरब्बा तैयार है।

अदरक कैण्डी

अदरक के मुरब्बे की तरह ही अदरक को धोकर, छीलकर, इसके 1–2 सेमी. मोटाई के टुकड़े काट लें। इसमें 2 प्रतिशत सिट्रिक अम्ल डालें तथा एक घण्टे के लिए ऊबालें। पानी को फेंक दें। इसके बाद 30° ब्रिक घोल बनाएं। यह बनाने के लिए 3 भाग शक्कर तथा 1 भाग पानी ले, इसे ऊबाल कर मल–मल के कपड़े से छान लें। इसमें अदरक डाल कर 15 मिनट तक पकायें तथा इसे रात भर शक्कर पानी में डूबे रहने के लिए छोड़ दें। इस बात का

ध्यान रखें कि अदरक के टुकड़े शक्कर पानी में पूर्ण रूप से डूबे हों। अगले दिन इस घोल को 20–25 मिनट तक पकायें इसका ब्रिक 35–40° तक हो जायें। यदि आवश्यकता लगे तो इसमें शक्कर भी मिलाया जा सकता है। इस क्रिया को दो तीन बार दोहरायें जब तक कि इसका ब्रिक 60° तक हो जायें। इसमें थोड़ी मात्रा में सिट्रिक अम्ल मिलायें (0.5 प्रतिशत शक्कर के घोल के अनुसार)। पकाने की क्रिया को एक दो दिन दुबारा दोहरायें। इस क्रिया का तब तक करें जब तक ब्रिक 75–80° पर पहुँच जाये। जब यह गर्म हो तभी छान कर अदरक को अलग कर लें। धूप में 4–5 दिन तक सुखायें। अन्त में इस पर बारीक शक्कर का बुरादा लपेट कर वायु अवरोध डिब्बे में भर कर रखें। बचे हुए शक्कर के घोल को दुबारा प्रयोग में ला सकते हैं।

अदरक का शर्बत

ताजी अदरक को धो कर छील लें। इसके टुकड़े काट लें। जितनी अदरक ली है उतना ही पानी एक पतीले में लें। इस पानी को उबालकर ठण्डा करलें। कटी हुई अदरक को मिक्सि में डालें तथा इसमें थोडा से उबालकर ठण्डा किया हुआ पानी डालें। इसे मिक्सी में पीस लें तथा मलमल के कपड़े से छान लें। अब इस छने हुए अदरक के पानी में 2 प्रतिशत सिट्रिक अम्ल मिलायें। तथा इसे रात भर के लिए ढक्कन लगाकर छोड़ दें। अगले दिन अदरक के पानी को सावधानी से बिना हिलाए एक दूसरे बर्तन में निकाल लें। पहले वाले भगोने के तवे में सफेद रंग तलछट दिखाई देगा उसे अलग निकाल कर सूखा दें। अब इस अदरक के पानी के बराबर शक्कर डालें तथा इसे तब तक पकायें जब तक इसका ब्रिक 65–70°C ब्रिक तक न हो जाये। बोतलों का संग्रहण ठण्डे स्थान पर करें।

अचार

अदरक को धोकर छील लें। अब इसके चौकोर टुकड़े काट लें। अब उन टुकड़ों को छाया में सूखा लें ताकि इसका बाहरी पानी सूख जाये। अब इसमें अजवायन, काली मिर्च, लाल मिर्च पाउडर, साईट्रिक अम्ल, जीरा, दाल चीनी, नमक मिला लें (सभी मसाले का 10 ग्राम और 250 ग्राम अदरक के टुकडे), इन सभी को एक काँच के बोतल में डाल कर धूप में दो सप्ताह के लिए रखें। बीच–बीच में इस बोतल को हिलाते रहें, आपका अचार तैयार है।

चटनी

अदरक को धोकर, छीलकर काट लें। अब इसे तेल में तल लें। अब इसे मिक्सी में पीस लें। अदरक के बराबर मात्रा में इमली को भिगोकर इसका पेस्ट बनालें। इसमें 100 ग्राम लहसुन का पेस्ट मिलायें। एक कढ़ाई में सरसों का तेल गर्म करें। इसमें 100 ग्राम साबुत लहसुन, 20 ग्राम मेथी

Ginger
Sharbat
Sharbat
Ginger Sharbat
Ginger Sharbat
Ginger Sharbat

दाना डालकर तलें, इसमें इमली का पेस्ट डालकर पकायें इसमें अदरक का बना पेस्ट डालें। नमक तथा गुड़ स्वाद के अनुसार ड़ालें। इसे ठण्डा करके काँच की बोतल में भर कर सूखे और ठण्डे स्थान पर रखें।

अदरक का तेल

अदरक का तेल भाप आवसन (Steam Distillation) क्रिया के द्वारा प्राप्त किया जाता है। इसके तेल का प्रयोग साफ्ट ड्रिंक, बियर तथा भोज्य पदार्थों में स्वाद बढाने के लिए किया जाता है। अदरक से तेल निकालने के लिए उसे सूखा कर पाउडर बनाया जाता है तथा आवसन (Destillation) प्रक्रिया द्वारा निकाला जाता है। साधारणतः सूखी अदरक से 1.5 प्रतिशत से 3.8 प्रतिशत तेल निकाला जा सकता है। अदरक की किस्म के अनुसार तेल की मात्रा कम ज्यादा हो सकती है।

5. भविष्य की सम्भावनाएँ

पहाड़ी क्षेत्रों में जहाँ पर बन्दरों तथा अन्य जानवरों द्वारा फसल को नुकसान पहुँचाया जाता है वहाँ अदरक की फसल को उगाया जा सकता है। अदरक में खनिज लवण खास कर कैल्शियम अत्यधिक मात्रा में होता है। यह खनिज लवणों की कमी के निवारण में सहायक सिद्ध हो सकता है। अदरक के प्रयोग द्वारा बने पदार्थ बाजार में लगभग नहीं के बराबर है। अतः अदरक के बने पदार्थ की हमारे देश में व्यापक सम्भावनाएँ हैं।

TRAINING UNDER THE PROJECT
AGRIBUSINESS MODELS OF VALUE ADDED UNDERUTILIZED FOOD
PRODUCTS TOWARDS
LIVELIHOOD SUPPORT OF HILL STATES
खाद्य एवं पोषण विभाग
अदरक शर्बत और कैंडी
कृषि विज्ञान केन्द्र काशीपुर
प्रशिक्षण कार्यक्रम